A STUDY INTO THE LEARNING OF BIOSCIENCE BY STUDENT NURSES

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ABSTRACT

Background: The introduction of the Diploma in Nursing Higher Education (H.Ed) in the late eighties and early nineties resulted in a substantial change in the way that nurses were trained. While the new courses included much bioscience within the curriculum there continues to be concern about how the students link the formal theory that they are taught in the classroom and their experiences in the practice setting. Many of the events occurring in the practice setting are wholly dependent on knowledge of bioscience yet evaluations made of the Diploma since 1995 suggest that bioscience theory is being taught unaccompanied by the opportunity to understand it in practice. This suggests a very large knowledge gap in essential teaching.

Aim: This study sought to identify the processes that student nurses use to bring about a learning of bioscience that informs their practice.

Design: An action research approach was begun and qualitative methods used to collect data from nursing students on the Diploma of Nursing course. They were: nominal group technique, focused interviews, the recording of critical incidents and learning style assessments questionnaires.

One hundred and twenty students in all took part in this study.

Findings: The results that emerged from the data suggested that the dominant factors in the learning process for the students were the presence of the real patient and other professionals. Interactions with patients aroused emotional feelings and their presence assisted in promoting bioscience learning that was useful to the students in subsequent practice. Students claimed that they relearned this subject beginning with the disordered bioscience that they met in the placement setting. In order to achieve this learning students' changed their learning style for this subject. They made no attempt to link the previous taught theories of the classroom with what they saw in practice.

Conclusion: The learning process preferred by the students was based on problem-solving and involved a change to the students' initial learning style. Future teaching methods for the subject of bioscience should be based on *real* patients and their problems as encountered within the clinical setting. The action research cycle could not be completed at this time due to the nature of other new changes to the nursing programme from government directives.

Key words: Bioscience, clinical practice, student nurses, learning style, *real* patients.

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CHAPTER 1

INTRODUCTION

When I was a nursing student we wore starched caps, collars
and aprons. Research and evidence were never mentioned.
I was taught procedures such as promoting scab formation
on chronic wounds even though such practice impeded healing.
My clinical sills were pitiful. I could not carry out venepuncture,
cannulate patients or perform male catherisation. My knowledge
of anatomy, physiology and biochemistry were woeful

(Nazarko 2006, p14).

These comments relate to much of the nurse training that took place prior to Project 2000 at the beginning of the 1990s. Project 2000 was seen as radical and an improvement. During the last 15 years evaluations of the Project 2000 type training continue to reveal that there are concerns regarding various aspects of the programme (Hislop *et al* 1996, Parker and Carlisle 1996, Maben and Macleod-Clark 1997, Fulbrook 2000). Their findings show that some of these concerns relate to the learning of bioscience and the linking of the theory practice. It seems that the Project 2000 type training has not rectified the deficiencies of the old programme. According to (Nazarko 2006) traditional methods of teaching, clinical mentorship and link lecturers will not deliver the knowledge and skills that the student requires today. Education and practice have to have a better union than they have at present.

During these years the professional role of the nurse has expanded. Two of the changes especially have major implications for nurse training. The first of these is the European Working Time Directive. Commenting on the shortage of doctors the idea was put forward that nurses take on the skills that had previously been part of the medical role (Clarke and Levy 2006). In early 2006 the Government of the UK announced that legislation allowing registered nurses to extent their prescribing responsibilities to include any licensed medicine except controlled drugs and unlicensed medicines was now in place (Pearce 2006). In the light of these comments today's student nurses need to know how to diagnose, carry out physical assessment skills and to prescribe drugs and this includes an education to inform their practice especially in the clinical setting. All of these skills require an understanding of bioscience.

Bioscience includes those aspects of anatomy, human biology, microbiology, pharmacology and natural sciences used by the medical and nursing professions to inform their practice in relation to the treatment and care of their patients (Akinsanya 1987). For the purpose of this study the generic term bioscience also includes those aspects of the natural sciences such as physiology, genetics, biochemistry and pathology used by the nursing profession to inform their practice.

Nursing practice is mainly concerned with the welfare of patients who have suffered a biological disturbance. To practice safely, effectively and autonomously, nurses need to understand the biosciences that underpin nursing actions (Jordan and Potter 1999, Jordan *et al* 1999, McKee 2001). A common feature arising from the literature is the problem that students face when attempting to apply concepts from the supporting bioscience to their nursing practice. Jordan (1994) suggests that this problem stems from the teaching of biosciences and the frameworks which students use to conceptualise this information. She claims that these frameworks are not rational but intuitive. Chapple *et al* (1993) sees the problem as one of the depth of bioscience presented to nursing students in that the subject is too detailed, making it difficult for students to determine what is important for them as practicing nurses. This leads to a claim that without the design, implementation and evaluation of effective teaching strategies, bioscience will continue to give nursing students disproportionate difficulty and, as a result, students will be unable to make clinical decisions based on the understanding of the bioscience phenomena encountered in practice (Eraut *et al* 1995, Davies *et al* 2000). The challenge facing educationalists is to find teaching strategies that will develop the student's theoretical thinking abilities in bioscience and provide an integration of theory and practice (Lumb and Strube 1993, Don 1995, Jordan *et al* 1999).

In 1999, the United Kingdom Council for Nursing (UKCC) advocated critical scrutiny of the relationship between education and clinical learning in order to find a new basis on which nurse education might go forward. The Council assessed new proposals announced by the Government as an opportunity for a review of the pre- registration nursing curriculum and the strategies that were used therein to teach the subject of bioscience. It envisaged a curriculum with a one-year foundation or core programme of relevant subjects that all nursing students would study. Bioscience was to be one of the subjects within this new core curriculum (Davies *et al* 2000). Also in 2000 radical reform required by the Government meant that all NHS training and education would have to be reshaped around the provision of care for the patient (DOH 2000). There would be a new joint training and a core curriculum for the undergraduate education programmes of all health professionals with a pre- condition that all practitioners would be able to demonstrate competence in named skills on qualification. The Government was seeking innovative ways of developing opportunities to build a diverse workforce within health care. Every health care profession was urged to take a new look at its practices and seek to find new ways of working and learning.

AIMS OF THE STUDY

I came new to education in 1989 and spent three years as a newly qualified teacher in a School of Nursing before moving into the University setting. The majority of my teaching time was spent trying to impart an understanding of aspects of bioscience to students and supporting them while they were undertaking periods of clinical practice. It was during this time span that I began to be aware of the many examples of a lack of bioscience knowledge and understanding on the part of the students with respect to their patients.

To illustrate this the following example is cited. Many students in the clinical practice setting, on seeing patients who were breathless identified this as a sign of respiratory malfunction and failed to understand that heart failure or anaemia could also present in the same way. The ability to see the body as a functioning interrelated entity eluded them. Altered bioscience that originates from different body systems requires a different care prescription and correct choices about patient care. The importance of making the correct choice was recognised by the student but the change in the patient's bioscience that guided that choice was not. In the lecture theatre they evaluated the subject as boring and complained that they never saw patients as described by the lecturers. But, they were very interested and motivated about bioscience when the abnormal bioscience of the patient that they saw in practice was discussed by the lecturer and contrasted with the normal which was themselves. It was apparent that there were problems for the students with this subject that were especially worrisome. The project 2000 programme was a *new style* of nurse training that was rated as better than the *old* but after teaching within the new programme for another few years I became aware that the problems of the *old* persisted. The continued presence of the *old* problem for the subject of bioscience seemed worthy of investigation.

Bioscience is a subject that students find difficult to learn and to understand (Wharrad *et al* 1994, Race and Holloway 1992, Don 1995, Jordan *et al* 1999). Yet despite these difficulties the majority of students beginning their training will go on to successful completion of their course and become competent practitioners. Somehow they appear to discover a way of understanding the bioscience that is presented to them every day in their practice. The implication is that factors within the practice part of their programme promote their learning of bioscience and contribute to the development of a learning process. This study seeks to identify those factors by engaging in clinically based research and reflection on action strategies.

It is envisaged that the findings of this study will foster the development of a different teaching approach to the study of bioscience. But this requires an explicit knowledge of the factors that influence the relationship between the students' learning of the subject and the teaching environment within which the student learns. There are many external factors in the form of organizational imperatives, legislative requirements and the clinical setting itself that affect learning for these students. An effective teaching strategy needs to be able to accommodate these factors and utilise them in a different way from what has previously been done.

Nursing along with other health care professions such as medicine and physiotherapy, is a practice-based profession which has a theory-practice gap that has long been recognised (DOH 1994, Sherman and Talbot 2000, Pang *et al* 2003). Attempts to close the gap have relied on the generation of theory through research in the belief that many practitioners will translate the findings into their practice (Rolfe 1996). The fact remains that practitioners have not incorporated such findings into practice within the clinical setting and so the theory-practice gap remains undiminished. This study sought to seek information from within the setting where the learning was taking place in the belief that data that emerged from reality was more likely to be implemented than theoretical constructs.

Following the Introduction this study is arranged over seven chapters.

Chapter two examines the place of bioscience in the nursing programmes The review identifies teachers of health care professionals as facing a dilemma with respect to how much bioscience should be taught, how it should be taught and asks who should teach this subject to undergraduate students. It discusses the apprenticeship model, the role of the clinical teacher and how teaching in the clinical setting inclines towards the acquisition of usable skills rather than theoretical comprehension. This is followed by an exposition of the changes that have taken place in the last thirty years both in the sciences and in the education of health care professionals contrasting the situation of nursing with that of medicine. A critical examination of evaluations of scientific learning, teaching and theoretical frameworks and integrating theory and practice follows. Finally there is an exploration of problem based learning with a review of its various uses and definitions within health care education to date. Recent evaluations of bioscience in nursing programmes within the last ten years are considered.

Chapter three concerns the methods used to collect the data for this study. There is a description of the methods used and the rationale for the choice of an action based approach. The composition of the sample group and the limitations imposed on the selection of this group are considered. An explanation of how each data collection method was executed follows, accompanied by a description of the data and the steps employed to achieve validity and reliability of findings. The limitations of the study are revealed and an interpretation of how these limitations could have affected the outcomes of the study is provided. The chapter concludes with consideration of the ethical issues involved for the clinical areas and the participants.

Chapter four reports the results from each of the data collection methods used. The findings are described in detail Common themes emerging from all three sets of findings are highlighted.

Chapter five critically analyses and reflects on the findings in relation to the literature of chapter two. The impact of the patient and the clinical learning environment on student learning are presented. There is reference to the psychological theories of motivation and how they contribute to learning within the clinical setting. Emotion and its impact on clinical learning are explored. The end reflective section questions the behaviours of students as they attempt to learn bioscience in the clinical setting and makes the case for the development of a learning style that equates with that of problem based learning. The intention for further exploratory studies is revealed.

Chapter six seeks to investigate further the findings from the data reported in chapter four that indicated that students' learning was effected by the clinical setting, the presence of the real patient and the emotional factors generated when the three existed together. The implications of the data are considered in the context of the literature on learning styles and how these are affected by teaching approaches. There is a further review of the literature focusing on tools used to ascertain learning styles along with their advantages and disadvantages. This is followed by a description of the procedure that was followed to obtain information concerning the learning style of a group of students throughout their entire first year of training. Limitations of the study and ethical issues are considered.

Chapter seven relates the findings following the application of the Honey and Mumford learning style questionnaire to the students and attempts to expose what was found using descriptive analysis.

Chapter eight examines the findings from the learning style questionnaires and relates them to the various theories of learning. There is an in depth examination of the components of the hybrid learning style. The limitations of the findings are discussed. The final section of this chapter reflects on the findings and expresses the personal views of the researcher.

The concluding chapter nine draws together all the findings and proposes recommendations for the future teaching of bioscience for health care professionals and for further research.

CHAPTER 2

REVIEW OF THE LITERATURE

2.0 Biosciences within the nursing

Bioscience has featured in nursing curricula since Nightingale's day (Quinn 1995). The relevance of bioscience to nursing practice has long been acknowledged. The General Nursing Council for England and Wales and the European Economic Union recognise this by including bioscience in the syllabus of training and in the examinations leading to registration (Quinn 1980 cited in Montague 1981). Jordan (1994) asserts that the physical care of the patient is dependent on such knowledge. Despite Jordan's comment, a study of the role of the bioscience in nurse education throughout the eighties suggests that much lip service has been paid to its contribution. The profession appears to be content to neglect the teaching and learning of bioscience and allow future generations of learners to continue to struggle for a strong knowledge base, while teachers of nurses concentrate heavily on improving communication and interpersonal skills. (Akinsanya 1986, Gould 1990, Clark 1991, Jordan 1994). The reason for this neglect seems to lie in part with the fact that nursing had borrowed its theoretical underpinning in bioscience from medicine. The subject was consequently too biomedical in focus and was taught by doctors. An analysis of textbooks for nurses confirmed that the application of bioscience to nursing practice was largely derived from medical science (Akinsanya 1985). However the nursing perspective in these texts has been refocused to take a more holistic view of man and to be concerned with action aimed at the whole person or macro level instead of the micro level of the medical profession. Medicine and the biomedical model were concerned with whether or not pathology compromised health in the individual. They were disease orientated, concerned with abnormalities of biological processes at cellular level (Wynne *et al* 1997) and took a reductionist approach that assumes that the whole human being could be understood by reconstituting the parts (Akinsanya 1986, Trnobranski 1993). Although nursing and medicine shared the common aim of seeking to restore normality of health to their patients, they seek to achieve this aim from different starting points (Trnobranski 1993).

Dissatisfaction with the reductionist biomedical model amongst nurse educationalists prompted some authors to suggest that the bioscience area of the curriculum should be abandoned (Holford 1981, Starck 1984) and the social sciences allowed to replace it. A growth of interest in the social sciences led many nurse educators to seek professional autonomy in the social sciences component of the curriculum with the result that there was a failure not only to develop the bioscience subject area (Jordan 1994) but also the teaching of bioscience. Consequently many lecturers felt even more poorly equipped to teach this subject than they had before the shift in nursing education towards the social sciences (Gould 1990).

It was against this background that the United Kingdom Central Council (UKCC) for Nursing, Midwifery and Health Visiting (1986) stated that the new preparation for nursing practice, Project 2000, should include bioscience relevant to nursing practice, normal and disordered structure and function, the nature and causation of disease, and aspects of microbiology and pharmacology. The provision of effective care depended on an understanding of the patient's physical condition (Trnobranski 1991, Jordan 1994) and this included the study of applied bioscience, and not just bioscience theory. These comments were supported by the earlier findings of Courtney (1991).

Courtney had based her comments on a small-scale study she had undertaken in an attempt to assess the beliefs of students and teachers at her own teaching establishment. She had been concerned about the adequacy of bioscience in the nursing programme currently being run and the teaching methods employed. Using questionnaires she canvassed the views of 140 final year student nurses and 43 teachers from three colleges where pre-registration training was taking place. The questions were arranged in categories and asked students to rate subjects from behavioural to bioscience in order of perceived importance. A final section of the questionnaire was aimed at the teachers and asked them to indicate which teaching methods they used the most often to teach bioscience.

It is not clear whether the type of questions asked were open or closed in nature or whether Courtney obtained this information over a period of time or on just one college day. Obtaining this information in just one day would have had the effect of making this sample a convenience sample. Polit and Beck (2004) describe this method of obtaining respondents as a easy and efficient way of getting a good quota of students but not necessarily the best way to obtain a representative sample. Persons who subscribe to a convenience sample are often those who volunteer and who feel the most strongly about the topic in question, resulting in biased data. Another difficulty is that the type of questioning used could have involved many closed questions. Closed questions do not invite the respondent to explain and this loss of explanation may result in vital information being left unmentioned. Sometimes the question causes uncertainties in the participant concerning understanding and the question may be left unanswered (Stevens *et al* 1993, Bowling 2000).

Despite this Courtney's findings showed that the students expressed a great deal of concern about learning the subject of bioscience. They had strong reservations about what they had been able to assimilate and felt demoralised and confused. Fifty one per cent of students (n = 71) considered bioscience to be the most important subject taught on the programme in comparison with only 27% (n = 12) of the teachers. According to the students the most effective methods of teaching were clinical experience and project work whilst the teachers' choice of preferred teaching methods were the lecture and self-directed learning. All the teachers were unsure of the degree of depth of understanding required by the students while the students also claimed to be unsure of what to learn. Teachers questioned in this study were of the opinion that bioscience had been taught with an emphasis on the *pure* source discipline rather than with an orientation towards practice. The results of Courtney's study were of concern since they suggested that firstly the teachers themselves did not know how much knowledge was required to understand practice and secondly they suggested that the teachers lacked the skills necessary to use other methods of teaching that could be more beneficial to their students.

Despite their limitations, the findings were important enough to demand further study, especially with respect to bioscience content of the Nursing course and the ways in which this subject is taught to students. The ability to apply theory to practice particularly warrants research since most persons requiring therapeutic intervention from health care professionals do so primarily because of disordered bioscience. For example the Royal Free Hospital annual admission statistics indicate that 98% of the patients treated as in-patients during the year 2001-2002 had some form of bio-malfunction as opposed to a psychological disturbance.

2.1 The traditional programme of nurse education

From the formation of the NHS in 1948 until the late 1980s, nurses in training were employees of the NHS and, as such, formed an important part of the workforce. This system of preparation for the role of the registered nurse was described as one of apprenticeship. Students learned to be nurses mainly by caring for patients in a working situation, supplemented by blocks of theory in a school of nursing. Clinical work was sorted into tasks within a placement setting and the complexity of the task increased with the seniority of the student (Akinsanya 1986, Parker and Carlisle 1996). This form of nurse preparation posed the problem of being an uneasy compromise between the areas of education and practice (Bentley 1996). Melia (1987) suggested that it encouraged students to see theory as college work and practice as ward work. These two opposing ideas, that theory belonged to the teachers and practice to the clinicians, presented two different versions of nursing, the idealised version as taught by the educationalists and the more pragmatic version that occurred on the wards, thus creating what is recognised as the theory-practice divide (Orton 1981, Marson 1982, Ogier and Barnet 1986, Jowett *et al* 1992, Andrews and Jones 1996).

2.2 The traditional nursing curriculum

The intention of the nursing currriculum is to develop a nurse's skills through programmes that value intellectual and cognitive abilities, thus enabling students to use rational processes, to analyse and to make clinical judgements (Greaves 1987). Value for the intellectual skills of the nurse should extend equally to the practical aspects of the course. The classic curriculum model for nursing education was based on objectives and arose out of the work of Bobbitt (1918) who held that education was an intentional activity and should prepare the student to carry out specific activities. The idea of objectives was based on the work of Tyler (1950) in which it was suggested that the best way to use objectives was to express them in terms which identified the kind of behaviour that the student was expected to display in a particular context (Stenhouse 1989). The use of objectives was supplemented by the work of Bloom (1956) and Bloom *et al* (1964), who provided a taxonomy for objectives in which the intellectual activities of the student could be categorised and compared.

Although this curricular model was not initially designed for nursing it was extensively adopted by nursing programmes in both the UK and the USA (Greaves 1987). It led to an objectives-based nursing curriculum model that focused on the control of nursing rather than its enhancement (Bevis and Watson 1989, Deikleman 1990, Clare 1993). The learning of nursing involved achieving the objectives of the clinical skills in the clinical setting while the knowledge required to make sense of the skills was taught in the educational setting. Thus the objectives model served to divorce theory from practice. Consequently during clinical procedures many nurses relied on ritualistic routine rather than an understanding and application of fundamental principles. Nurses were encouraged to *do* tasks but not to ask *why* (Trnobranski 1993).

Evidence of change relating to the apprenticeship approach to nurse training began to appear during the 1960s when nursing embraced the ethos of scientism and began to develop its own knowledge base (Trnobranski 1993).

This knowledge base arose out of research into various aspects of healing and illness and included studies such as those of Fritzpatrick *et al* in 1983. This study investigated the social effects of illness for the individual and detailed how age, sex, the membership of either a social group or an ethnic group resulted in wide differences in illness behaviour of a collection of individuals who were afflicted by the same disease syndrome. It appeared that an individual's illness status was influenced by many factors within their living situation and that effective care would require giving consideration to these factors.

In contrast the medical approach concentrated on identifying physical signs and symptoms in order to arrive at a diagnosis. There were emphases on the absence of disease, on pathology and on cure, but critical assessment of the approach led to beliefs that it was failing to live up to its promises of cure and accurate diagnosis. There was an increasing rate of misinterpretation of the patient's condition as a diagnosis could be arrived at without the recognition of the psychological and social dimensions that affected the individual and his sickness status (Ferguson 1984, Walton 1984).

Such research findings concerning patient care caused nursing to lean towards a more holistic philosophy of care and professional independence (Kramer 1990). Holism is described as the recognition of the individual as having social and cultural dimensions which affect his response to disease as opposed to the idea suggested by the medical model that disease is nothing more than a disturbance of physiological body function and as such can be treated in isolation (Ferguson (1984, Trnobranski 1996, Wynne *et al* 1997). The inability of the medical approach to explain some of the phenomena that nurses encountered led to the significant use of models of care which excluded the medical approach. The nursing profession and curriculum chose to develop their knowledge around subjects that were seen as more compatible with the holistic approach to nursing. Such subjects included sociology and psychology (Trnobranski 1993). A secondary result of this change in emphasis in the nursing curriculum was that bioscience, which was seen as part of the medical model, came to be devalued. Drew (1988) proposed that in recoiling from the medical approach nursing had unintentionally narrowed its scope, while Wynne *et al* (1997) saw this marginalisation of bioscience as no more than a widening of the nursing curriculum to allow other relevant subjects their rightful place. The strong reliance that nursing had traditionally placed on the medical staff for the teaching of bioscience had disadvantaged nursing as it had led to a lack of research into the teaching and learning of a subject that was an important source of knowledge for nursing theory (Akinsanya 1987, Trnobranski 1993).

2.3 Approaches to teaching and learning on the traditional programme

A substantial portion of the formal education and preparation of student nurses was carried out by tutors in the classroom and practical room settings within schools of nursing. Tutors were expected to teach all the sciences considered relevant to the course. Akinsanya (1985) and Courtney (1991) expressed concerns about this practice, especially for the teaching of bioscience, since so few nurses had degrees in this subject (Trnobranski 1993).

Teaching methods involved the extensive use of lectures and the demonstration and rehearsal of practical skills within the skills areas of the educational centres. Although tutors spent some of their weekly teaching time on the wards, the demands of their educational role tended to keep them away from the clinical area (Jacka and Lewin 1987, MacLeod-Clark and Hockey 1989). As early as 1968 in analysing the opinions of the ward sister Dutton (1968), expressed the view that most felt that the tutor's clinical teaching was out of date and not related to the work of the ward. The tutor lacked responsibility at ward level and, as a result, felt demotivated, which led to infrequent teaching at a clinical level (Owen 1993).

A second grade of teacher, the clinical teacher, was also in existence at that time. They were intended to extend the amount of time spent teaching students in the clinical setting, but many ward areas saw this person as a critical interloper and made them feel disadvantaged (House and Sims 1976, Wyatt 1978, Alexander 1982, Bell 1982, Owen 1993). The teachers themselves complained of feeling like guests, and being likely to lose their clinical expertise (Weatherstone 1981). Students saw clinical teachers as being overly concerned with assessment, remote and unable to teach the skills of adaptation needed in the rapidly changing environment of the practice setting (Wyatt 1978). In a survey in 1976 of 2,923 teachers of nurses House and Sims (1976) noted that teachers exhibited anxiety and frustration. The role of teaching the students in the clinical setting was in need of greater definition from its educational leaders (MacLeod-Clark and Hockey 1989).

In the traditional programme many wards had a set teaching schedule based on their medical or surgical specialism and carried out regular teaching sessions throughout the week on different aspects of patient care. There was an emphasis on acquiring an understanding of the patient's condition based on their disordered bioscience. Research undertaken suggests during this time one of the most effective teachers was the ward sister and her immediate trained staff (Fretwell 1982, Ogier 1982, Marson 1982, Alexander 1984, Owen 1993). Ogier's study in particular looked exclusively at the ward sister's teaching role and her influence on student learning. This study used a questionnaire based on a modification of a well-tested instrument-Fleishman's Leadership Questionnaire (1969). Responses were obtained from 193 student nurses using the questionnaire, while interviews were used to obtain data from 178 trained staff. Both the questionnaires and the interviews had open-ended questions that allowed for greater discussion of the clinical environment and the learning opportunities identified therein. Ogier's study identified the ward sister as having the greatest positive or negative impact on student learning. The sister who had a positive effect on student learning was seen to be knowledgeable, professionally skilled and showed an ability to adapt effectively to the differing demands of the clinical setting, but she was also approachable and found time to talk to and teach her students. It seemed that the ability to teach effectively at the clinical level is greatly enhanced by the possession of good communication skills or that the possession of good communication skills made that person more likely to teach. Either way the student response resulted in an enhancement of their learning.

Ogier's study in 1982 used volunteers from both the student and trained staff population. It can be argued that this population is skewed since only those with an interest in teaching students or students who have had a good experience of ward sister teaching would have responded. However despite the limitations of a skewed population, this study has found support in the studies of other researchers who detail similar findings (Pembrey 1980, Leach and Lewin 1981).

Despite all these earlier influences inviting change for nursing education, Heliker (1994) that the newly trained nurses failed to exhibit evidence of a more patient centred, holistic approach to practice. French's (1992) analysis of the literature concerning nursing education since the 1960s, noted that the curriculum framework up to the early 1990s remained teacher-centred with the student as the passive recipient of information. This claim was supported by the findings of other studies, in particular those of Freire (1970), Sweeney (1990) and Vaughan (1990). Freire (1970) had been especially critical of teachers who deposited knowledge into their students, who in turn behaved as educational banks and passively accepted the deposit. In 1990 Bevis and Murray felt that there was still much evidence of this teacher centred curriculum, which they claimed was supporting authoritarianism. They saw a need to look at nurse education from a different perspective and to displace the existing curriculum with a more emancipatory one in which a direct relationship between the student and the learning would place the teacher in a more facilitative and consultative role.

2.4 Who should teach bioscience?

The effective teaching of bioscience as part of a course depends on the teachers having an adequate background in the subject. Until the beginning of the 1990s many nurse teachers were expected to teach varied subject material within the programme, with the result that much of what they taught was superficial, inadequate and out of date (Akinsanya 1985, Coutrney 1991, Trnobranski 1993). Since this time many teachers of nurses have developed their own specialist areas of teaching and have Master's level academic qualifications within the social sciences, health policy or ethics, but individuals qualified to teach bioscience remain few in number. This has led some teachers to support the option of microbiologists and physiologists being used to teach these subject areas (Wynne *et al* 1997). Where this has occurred the difficulty that the students experience when they try to learn this subject has increased, since these specialists are frequently unable to apply the relevant science to the reality of the practice area leading to persistence of the theory-practice gap (Trnobranski 1994).

McCaughtery (1991) and Clifford (1995) suggest that the bioscience problem is partly the result of a change to the role of the teacher brought about by organisational change and the recent political influences within higher education and the NHS. They argue that these changes have undermined the traditional relationships between education and the service sectors and, as a result, there is too much reliance placed upon clinical staff to meet the students' learning needs. Many nurse teachers have insufficient time to fulfil their clinical teaching responsibilities because of an increased teaching load (Hardiman 1993). This has resulted in their clinical teaching role becoming no more than a clinical liaison role. In addition Twinn and Davies (1996) claim the clinical practitioners do not keep abreast of educational change and this leads to confusion concerning assessment and the level of competency of students on placement. Clinical practitioners see student learning only in relation to the practical ability and hands-on skills in the practice setting, leaving the theoretical side to the educationalists. Educationalists who are also qualified professionals feel that they need to be able to claim clinical credibility and to justify the importance of clinical skills for their educational role, even though they spend very little time in the placement area (Goorapah 1997).

Alongside the difficulties of role identification is the question of keeping abreast of new developments in the specialist area. Crotty (1993) argued that clinical competence is not just about being able to perform practical skills but about being up to date. The two are inextricably linked. It is suggested that the role of the teacher would benefit from a clearer definition of the balance required between educator and practitioner (Birchenhall 1991, Burnard 1992, Crotty 1993, Goorapah 1997).

Concerns from practitioners and the educationalists relating to the perceived learning needs for the subject of bioscience have been endorsed by the Nursing Education Commission's findings based on evidence from 450 organisations throughout the UK (UKCC 1999). Part of the Commission's remit was to review the prescription of drugs and to set new authorisation criteria for different professionals to prescribe a variety of medicines under protocol (Sims 1997). Jordan (1999) states that such organisational changes have exposed the fact that most nurse teachers have insufficient knowledge to teach bioscience. He suggests that the answer lies in developing another approach to the teaching of this subject, and points to the failure of bioscience to adopt a discovery approach to learning as had been advocated by Nolan (1975) but never implemented. Students of the caring professions are adult learners and are more likely to learn in an educational programme focused on solving problems rather than learning in the current decontexualised settings of the lecture theatre and the seminar room. A White Paper on Primary Care: Delivering the Future (DOH 1996), had already expressed dissatisfaction with the skills and knowledge of professionals, including nurses, in primary health care. However, if the Government's proposed multi-professional approach to care is to improve practice, nurses need to receive adequate educational preparation in bioscience (Jordan *et al* 1999). Care of the highest quality will only be possible when practitioners hold the underpinning concepts and are able to integrate and apply them. The design, implementation and evaluation of effective teaching strategies for bioscience are therefore imperative (Akinsanya 1987, Maben and Clark 1997, Davies *et al* 2000).

2.5 How should bioscience be taught

MacFarlane (1976) and Hinshaw (1991) both supported the view that a sound scientific base was necessary for clinical practice but that it was also necessary to promote clinical and educational nursing research. A review of the literature prior to the 1990s, reveals a dearth of research into the role of bioscience in nursing education in the UK, with only two important studies (Nolan 1973 and Wilson 1975).

Nolan (1973) was concerned with the teaching methods that he had seen used to teach human biology in schools of nursing. He noted that during the sixties, in the field of general education, the field of biology had been revolutionised by the introduction of the Nuffield Foundation material in which the use of the discovery method of learning had been advocated and introduced. Awareness of these changes in 1962 caused the General Nursing Council (GNC) to recommend to schools of nursing that the subject syllabus for biology be less specific in order to allow the teacher freedom in the choice of methods used to teach and apply the subject to clinical nursing studies. Despite this recommendation, Nolan was of the opinion that the nursing profession was unaware of the changes that had taken place in school science education and that the effect on future students when learning bioscience within the nurse training programmes would be that of boredom and disillusionment with the conventional teaching they would encounter.

In order to support his theory Nolan (1973) used three groups of nurses to obtain information concerning the teaching of human biology in training schools. They were nurse tutors, recently qualified staff and student nurses at the end of their first year. He focused his questions on three aspects of bioscience teaching. These were the facilities and equipment available, the teaching methods used and the opinions of nurses towards human biology generally. Nolan used twelve schools of nursing from one Regional Health Authority and obtained data from 251 participants.

The findings of his study indicated that a sound knowledge of basic science and biology were required for nursing as a foundation on which to build clinical and behavioural knowledge. He argued more science, not less, should be included in the curriculum and it could be made more interesting and relevant if the subject was practically applied. The idea that biology was a difficult subject to learn was a notion that tutors had and which the trained staff and the students did not share to the same extent. Although the results of the statistical analysis of the data were not given, Nolan claimed that the difference in opinion between students and tutors was significant. Nolan's study also identified that nurse tutors were not aware of the improved teaching methods developed in the past few years, nor of the advantages that the new technique provided in bringing about a greater understanding of the subject. He concluded that teachers of nurses lacked both the knowledge and the skills to teach this subject and this deficiency, until it was changed, would continue be a source of conflict for future students.

One of the strengths of Nolan's study is the fact that he surveyed three grades of nurse from within the nursing population of different hospitals. The use of data from multiple sites along with the use of different levels of people to obtain viewpoints conforms to the triangulation criteria outlined by Denzin (1989) as space and person triangulation. Triangulation aims to demonstrate convergence such that data obtained from different sources or in different ways, yields similar results so improving the likelihood that the study findings are credible (Polit and Hungler 1999). Another strength lies in the use of a questionnaire that was tested in a pilot study to determine its ability to gather the data required reliably but perhaps the biggest strength of this study has been its transferability since the time of the research to the present day. The quality of this method is that the conflict predicted by Nolan then, continues to be detailed by researchers currently who reaffirm that the learning of bioscience in the educational establishment does not assist health care students to understand clinical practice (Nicoll 1996, Jordan and Potter 1999, McKee 2002)

2.6 Teaching strategies for bioscience

Despite the intense interest in the idea of new approaches for the learning of bioscience, other researchers appeared more interested in strategies for teaching that involved using well tried and tested conventional methods, especially for courses where there were large cohorts of as many as five hundred students annually, and a teaching staff complement that was not always supportive of small group teaching (Jordan and Potter 1999, Jordan *et al* 1999, Davies *et al* 2000).

In their small study examining the usefulness of teaching strategies Davies *et al* (2000) found that out of 294 students, 66% (n=164) favoured an expansion of small group teaching. Students were asked, via a questionnaire, which strategy used in the teaching of the basic sciences promoted their learning of the subject the most. Although closed questions do tend not to provide as much informative data as open questions, attempts were made to maximise validity by structuring the questions around issues raised about the teaching approaches used for bioscience as encountered within the literature. These were: which strategy was used the most, which strategy assisted students to learn the most, and was enough time allocated to the teaching of this subject. Inferential statistics were applied to the resulting data but the differences in proportions of students choosing particular learning strategies were not statistically significant. Davies *et al* (2000) had hoped to discover which of the strategies used to teach bioscience was the most efficient. The empirical evidence they sought was not forthcoming with students seeming to favour a mix of teaching approaches. However, their research exposed a more important issue concerned with the relevance of the taught material for practice. Many students did not consider any of the course content relevant to practice and this was supported by the findings of Davies et al (1996), Hislop *et al* (1996), Phillips *et al* (1996). What concerned the students was that their ability to apply what they had learned was not promoted by the teaching strategies currently being used. They felt there had to be a better way to learn this subject.

Despite the major limitations of the study by Davies being its use of one site only and of closed questions to obtain the data, numerous other studies are supportive of these findings (Waddell *et al* 1991, Davies *et al* 1992, Francke *et al* 1995, Grant & Stanton 1998, Bero *et al* 1998, Ghosh and Dawka 2000). It seemed that there was a need for some sort of curriculum design that brings about overlap of discipline-based knowledge and health care delivery using effective teaching strategies in order that students learn bioscience subject in a meaningful way.

In a similar study of medical students, Dammers *et al* (2001) also noted that students appeared to favour the small group teaching approach to learning that included bioscience. The question that interested Dammers *et al* was whether the patient could be influential in promoting student learning within the small group setting. The study followed 69 medical students through two years of their programme and used three methods of data collection, a questionnaire, observation and a weekly review process that involved discussion with the students' tutors. This setting was a clinical placement in the community at various health centres. Dammers' study found that patients intensify student learning and heighten their motivation to understand complex situations in a holistic manner. The students took it upon themselves to become more actively involved in learning and often transferred their learning to their patients by teaching them how to deal with their afflictions.

Dammers' study finds its strengths in the use of method triangulation in which three different data collections took place simultaneously and in the fact that it took place over a long period of time. As prolonged studies allowed for change over time to be detected the use of 69 students over a two year period would have been more likely to show the educational gains or lack of them as experienced by the students (Lincoln and Guba 1985). One-off data collections do not detect this information but instead tend to focus only on isolated occasions. Method triangulation also strengthens reliability and validity of the findings since the same findings collected using different approaches on the same student group would assist in neutralising the bias more often seen when using one method alone. This technique is also more likely to allow the presence of internally consistent phenomena to emerge (Polit and Hungler 2000).

To date there is little to no research to support the findings of Dammers *et al* (2001). Despite the fact that medicine like nursing is principally concerned with patients, no-one seems to have identified the contribution of the patient to the learning experience of the student. It appeared that there is still a need to find the optimum teaching strategy for the bioscience part of the curriculum (Parker and Carlisle 1996, Davies *et al* 2000).

2.7 How much bioscience should be taught

Wilson (1975) in contrast to Nolan looked at the biological content of the nursing programme. She concluded that the bioscience theory which underpinned nursing practice was unstructured and ill-defined, and that no clear indication had been provided by the educational bodies as to the extent of knowledge of biological science that was required by registered, practising nurses. Wilson collected information from 532 nurses, using a mix of qualified nurses and students in all years of their training, and from 179 doctors, who ranged from junior house officer status to that of consultant. She used the general medical and surgical wards within three general hospitals as a source of data and three different methods of data collection, observation, an objective test and a postal questionnaire.

The findings of her study suggested that the nurses' knowledge of biological science and the doctors' beliefs about how much the nurse knew were different. It seemed that there was a potential danger to patients because of this discrepancy since nurses, who saw patients more often on a daily basis than did doctors, would be more likely to make an incorrect judgement as a result of their inadequate understanding. Wilson proposed that the only way to improve this would be to change the teaching of student nurses and the environment in which they received their professional bioscience education.

Wilson (1975) used a postal questionnaire to obtain data from medical staff. Although she obtained a high response of 86%, (n = 104), postal questionnaires have the disadvantage that they cannot probe the informant for information and the reply given has to be accepted as final (Polit and Beck 2004). Answering questions in a different order from that indicated by the researcher can provide different data and this is another disadvantage of the postal questionnaire over which the researcher has no control (Polit and Beck 2004, Bowling 2000). Another weakness in Wilson's study was the use of objective testing as a research method to determine the understanding of the students' and the trained staff's knowledge of bioscience. Objective testing tends to identify superficial knowledge while leaving the understanding of the subject unexposed, and could have failed to allow the researcher to be fully aware of the true level of understanding of the trained nurses and the students (Davies 1981, Newble and Clark 1986, Snowman and Biehler 2000).

However the advantages of Wilson's study included collecting data within the natural setting of the hospital from a homogeneous sample, thus making the findings more amenable to statistical testing and generalisation (Bowling 2000). The use of three methods of data collection helped to reduce uncertainty within the findings and to minimise the personal biases that can come from the use of a single approach (Denzin 1989).

Wilson made recommendations for change within nurse education that included better preparation of the teacher to enable them to teach bioscience and that clinical staff must participate in the education of students. She saw the clinical setting as one of the most important learning environments contributing to the integration of bioscience theory and practice. Despite these suggestions the findings of the present study indicate that the difficulties of the 1970s and the present day remain unchanged. Although many of the conditions of student education such as supernumerary status have changed, questions concerning the bioscience component with respect to the quantity of this subject within the curriculum remain unresolved.

2.8 Learning in the practice setting

Writings on the nature of professional training express the need for formal theory not to be detached from real situations (Schon 1987, Jarvis 1992, Ashworth & Longmate 1993, Eraut *et al* 1995). Theorising is an integral component of practical activity whether or not the individual is open or receptive to formal theories (Woods and Barrow 1975). However, Parker and Carlisle note that there is a wide distance between the implicit theories of personal constructs of real situations and the formal accounts represented by academic constructions of the bioscience discipline (Parker and Carlisle 1996). Parker and Carlisle's study was carried out using a convenience sample of final year students at one large educational establishment. Data were collected using an instrument that had been developed using Osgood's semantic differential scale for the evaluation of educational courses (Hoste 1977). Students were asked to rate their experience on a scale of 1-7 by choosing an adjective to indicate how they felt about a particular concept. The scale was presented to the students in two parts, each part containing a scale that explored either theory or practice.

The Hoste scale had been used before by other researchers to test perception, and the tool was rated to be both reliable and valid (Harvey and Vaughan 1990, Hargreaves 1994). The main source of bias appeared to be with the choice of a convenience sample which relies on volunteers for the data collection and has a tendency to attract the most vocal or those desirous of being seen to comply (Polit and Hungler 1999, Bowling 2000).

The results from the study by Parker and Carlisle (1996) showed a consistent trend for the students to rate practice above theory. The practical elements of the course that had been experienced on placement exerted the most influence on the students' learning process. Such positive student perceptions of practice placements suggested that adequate attention had not been paid to the factors within the placement that produced such an effective influence on student learning. The findings of this study were corroborated by the later works of Hislop (1996) and Fulbrook (2000).

In a similar study into the learning of bioscience, this time using medical students, West *et al* (1982) related how students were exposed to a traditional teaching method versus a problem-based method. The problem-based part of the study was set in a community placement. The results of this part of the study clearly indicated that problem-based learning in the community setting had had the most positive effect on students' learning. Their attitudes, especially to the learning of bioscience, had become very positive. The researchers were unable to differentiate between the effect of the problem-based approach alone and the influence of the community placement on the students' learning. What had been outstanding was the very positive attitude of the students to the learning of bioscience and the recognition of its value for clinical practice such that learning was promoted. The importance of the clinical setting for learning within the new courses was identified by Dammers *et al* (2001), who had set out primarily to explore the feasibility of using real patients in a general practice module for fourth year medical students at Newcastle University in the UK. At the end of the module, an evaluation of the students' perceptions of the educational value of this approach to learning took place. It appeared that the use of small group discussion in conjunction with the *real* patient in a clinical setting magnified learning for the students involved. The clinical context seemed to create a strong motivation for learning. There was a complexity about real patients and this in turn led to elaborated learning (Coles 1990). Elaborated learning involved new information being incorporated into what the student already knew and then being used to extend networks of knowledge. The students wrestled with problems that had no easy solutions, for this was what real life was like, in contrast to theoretical descriptions of disease. Work on therapeutics involved the students in the considerations of aspects of bioscience.

2.9 Bioscience within the medical programme

During the time period when nursing was restructuring and rewriting its training programme, conventional medicine was undertaking an equal degree of redefinition of its programme. Medical education developed in a similar way to nursing in the UK in so much that it was originally based on an apprenticeship system. When the need for a foundation in bioscience relevant to medicine was recognised, these subjects were introduced as a preliminary to clinical studies. Thus was born the preclinical/clinical divide that persisted up until the 1990s. Each part of the course expanded without the moderating influence of the other, and without any integrated examination of the overall aims of the course (GMC 1993). In 1993 the General Medical Council (GMC) openly criticised this division of medical education, which it rated as being calculated to obstruct the acquisition of sound knowledge and to favour heavily the *crammer* and the *grinder*. As such, this method of education was identified as a disgrace to medicine (GMC 1993 p 5).

The Royal Commission on Medical Education in England (1993) reported that medical courses had become so congested and factual that their educational value was open to question. There were special criticisms for the part that basic sciences contributed to the programme (Anderson 1993, Jordan 1993). The report concluded that the bioscience curriculum should no longer be controlled by subject specialists but by a committee of both science and clinical teachers who were competent to teach effectively. Traditionally it was expected that students should have a solid scientific training before embarking upon their clinical studies but, in its consultative document of 1991, the General Medical Council stated that this desire for completeness should be abandoned. Only what was relevant to the stage of education should be included and, furthermore, a more integrated clinical curriculum should be adopted. Bioscience should contribute to the clinical training throughout the course (Anderson 1993, Jordan 1993, GMC 1993).

The idea of a core curriculum for all health care professionals was stressed in the report (GMC 1993). Clinical relevance was rated as being of prime importance in maintaining student motivation and encouraging understanding of the concepts taught (Calman 1993). Bond (1993) considered that prospective doctors were often disillusioned and stressed because the quantity of material that they were expected to learn and the material that was encountered were out of context and seemingly irrelevant to practice. The great bulk of what they were taught, during the first two years of the traditional course, was neither useful nor remembered especially. It was agreed that medical students needed to have a good scientific knowledge base but bioscience that had been taught out of context had the effect of demotivating students.

Medical schools were slow to appreciate change. If there was no longer the need to produce the complete doctor, the aim should now be to fashion multi-potential graduates (Jordan 1993). He argued the core curriculum should be defined in terms of skills, knowledge and attitudes, with explicit objectives. A bioscience curriculum that exceeded the core material stifled the development of critical reasoning and a favourable attitude to learning. To change health care meant a change in the behaviour of doctors, which meant changing medical education and the teachers and the students therein (World Summit on Medical Education 1994, Tosteson 1994). The traditional didactic patterns of teaching should be tempered by exercises that would allow students to encounter simultaneously the ethical, social, legal, economic and scientific aspects of clinical care. Such experiential opportunities encouraged a holistic approach to patients and assisted students to develop the skills to solve the problems that they met in clinical practice. One important way of achieving this goal was to use small group teaching and problem-based learning. All learning including that of bioscience would have to be more student-driven. Each clinical encounter was unique and required more than just knowledge and skills but also the ability to reflect on what had been seen and practised. Schon (1987) advocated that this reflecting should also include the subject of bioscience. The implication was that medicine was in need of a radical overhaul of its training, with a new course which put emphasis on the integration of bioscience with clinical practice within a core curriculum taught by competent teachers who would be an equal mixture of scientists and clinicians (Tosteson 1994). This tendency to present a surfeit of information to the students within the British medical schools was also apparent within similar establishments in the United States.

The first signs of a divergence between the basic pre-clinical sciences taught to students and the results of the teachers' research activities began to emerge in the early 1970s when the University of Pennsylvania appointed a committee to consider the reorganisation of the basic science component of its undergraduate medical training programme. In order to evaluate what was currently being done and to provide an informed basis for change, the committee used a questionnaire to collect information from the teachers of the basic science faculty. One hundred and seven members of staff were invited to complete an anonymous questionnaire that asked about the basic sciences and included chemistry, physics, mathematics, biology and statistics. Other areas investigated were teaching activities, involvement in research and the use of organisational models for the educational part of the undergraduate programme. Ninety four per cent (n=100) of invitees replied to the questionnaire.

The major findings indicated that in the previous two decades, with the world-wide increase in science knowledge, the faculty had developed research interests that overlapped into the basic science areas taught to students. The staff nominated another seven research subjects over and above those included in the school's list that had grown enormously in the last few years and named them as biology, immunology, molecular biology, oncology, physical chemistry, neurobiology and genetics. The final consensus based on those findings was that the organisation of basic sciences in the medical undergraduate programme should be linked to research in order to enhance research activities, and that there should be a greater contribution to the programme from clinical departments, along with greater interdisciplinary teaching. Some respondents were concerned about this decision and were of the opinion that the medical students' learning was being subordinated to research activities. Although the numbers of respondents expressing this opinion was not provided, it is assumed that it was a large enough to have warranted comment. This study was small and confined to one university. It is therefore difficult to generalise on the basis of the published report but the institution was considered similar to other research-intensive universities of the time (Crown 1991).

The study was repeated ten years later. This time, in addition to the basic questions of the first study, the investigation sought to identify changes in the research interests of the science faculty members who taught the basic sciences to medical students. In order to make a valid assessment of any

change, only persons from the basic science faculties were included in the study, as had been done in the first study. The findings showed that in 1977, 49% (n= 49) of teaching staff had research interests and in 1987 the number of research-active teachers had increased by 10% to 59% (n=62). The implications of these findings raised the questions as to the suitability of such researchers for teaching basic science to undergraduate students and, if researchers were not suitable persons to teach, who would be suitable? The findings of the 1987 study confirmed the findings of the 1977 study that research interests were encroaching into the basic pre-clinical sciences.
The expansion in scientific knowledge that taken place in the decade since the 1977 study had the effect of enlarging the content of the basic medical course. Many faculty teachers had not been trained in, and had not been prepared to teach medical students the so-called classical elements of bioscience that served to underpin the study of clinical medicine. Instead the teachers discussed their own special interest, especially their research. This was not appropriate for medical students, who were at a level of learning where they studied the functioning of a whole organ or a body system rather than the pathology or other aspects of the cellular minutiae (Crown 1991).

The 1987 study also highlighted another issue for the learning of bioscience that the number of lecturers of doctoral status as compared with medical qualifications had increased in recent years in the bioscience departments. During the period 1977-1987, for example, the proportion of doctoral staff had increased from 65% to 72%, while the proportion of medically qualified personnel had fallen from 24% to 18%. Since doctoral staff did not have the benefit of clinical training, they were unable to describe from experience the relationship of bioscience to clinical practice and this meant that students' understanding of an important concept could be compromised (Crown 1991). The findings of the latter study indicated that just as important as an ability to link bioscience theory to clinical practice was the question of the content of undergraduate medicine's bioscience. There were serious questions about the amount of bioscience and its selection. There appeared to be a surfeit of facts being related to students and many of these facts were not believed to be vital to learning clinical medicine. The result for medical education was increased concern about the role, content, organisation and the teaching of bioscience for undergraduate students of medicine.

Crown carried out his study in Pennsylvania School of Medicine in 1977 and 1987. The findings of his work posed two important questions; first, how much of the subject of bioscience should be included in the undergraduate programme, and second by whom should it be taught? Crown reckoned that this was a problem that was widespread and growing, not just in America but internationally.

What is important about both studies was that they were the first large, published, empirical studies that appeared to have questioned the value of bioscience in undergraduate medicine by providing evidence to support its argument. A research study that can be replicated is dependable (Polit and

Hungler 1999). On the second occasion Crown's research team was able to reveal an imbalance in the amount of basic sciences being taught to medical students and, in addition, to illustrate the change in the imbalance over time. Although it was still possible that their findings were the result of an error either in the method used or the instrument with which the data were collected, repeated findings suggest the transferability of findings to other similar establishments. As Lincoln and Guba (1985) assert, the provision of sufficient data allows for judgments to be made about whether what was detected could be happening in a similar context elsewhere.

The 1987 study in particular caused medical establishments in the USA to question whether the changes they had detected were exclusively theirs or part of a wider picture that could be found in the UK and other western countries. After all, western countries had programmes that were similar in the design of their curriculum, course structure and their expectations for students on the completion of professional healthcare training.

2.10 Bioscience in basic training programmes for other health professionals

Despite extensive searching within the published literature very little research appears to have been undertaken by other health care professionals concerning the subject of bioscience within a professional curriculum. Many studies and reviews express opinions about aspects of bioscience in health care education but few empirical works can be found to support them. Along with nursing, the field of conventional medical education has shown the greatest interest in developing new teaching and learning strategies for bioscience, and some small exploratory studies were found in the field of occupational therapy. Health professional programmes have many similarities - they are patient-centred, they need to apply theory to practice, and in the case of medicine and nursing they have been the subject to recent government criticism with respect to their professional skills of their graduates. Despite the paucity of research there is no reason to suppose that other health care professionals are not facing the same dilemma.

Considerations of the literature have so far identified the following common concerns within the medical and nursing programmes. Bioscience is a most important subject but to what level should it be learned and who should teach this subject so that it informs practice. During the 1970s two important studies attempted to address two of those issues. They were the works of Nolan (1973) and Wilson (1975).

2.11 Government changes for health provision

While nursing and medical education were both critically examining their roles during the late 1980s, political factors within the UK brought changes to the approach in health care planning (United Kingdom Central Council for Nursing (UKCC) 1986). Health Authorities were to move away from their tradition of thinking about hospitals and programmes of financial planning around hospitals. Their goals were to provide local, accessible and appropriate services to give support to people in their homes and to find new forms of residential care, as well as continuing to provide hospital services. This was meant to redress the balance between hospital and community care in order to provide a range of services for a district rather than concentrating on the high technology health care centre of the hospital.

Three themes emerged from the government's plans for the NHS. The first theme focused on developing services for patient/client groups. A second theme related to the financing of these services, but it was the third theme that had the greatest implications for the education of health professionals. This was a recommendation that the health system should stress health promotion and disease prevention in both primary health care and the community and no longer concentrate on curing disease (UKCC 1986). Acute hospitals were seen as less appropriate places for students beginning to learn.

We feel that the time has come to break with the hospitals as the basis for so much initial practice and for new thinking about how placements and practical experience could be developed in relation to a whole range of care settings. Educational institutions of the future will need to relate to a whole geographical community and to all the health problems and all the health care facilities in the catchment area

(UKCC1986, p19).

New approaches to the delivery of care would have to begin.

The solution to this problem was seen to be a complete change in the way in which pre-registration education for health professionals was organised. According to all the reports concerning nurse education accumulated by the UKCC (1986, p 13) *the time had come for a new service/education contract that would better serve the NHS and nurse education.* This change was seen by nursing as the opportunity to replace the apprenticeship system of education with a system that met the new health care focus and allowed the students to be supernumerary. Nurse education was about to begin to move towards the uncoupling of education from the direct and persistent control by service (Bentley 1996).

2.12 The new programme in nursing education

Project 2000 was launched in late 1989 following a Royal College of Nursing report that was the culmination of a series of enquiries into nurse education by different professional groups such as the UKCC, in which the quality of previous courses for nurse preparation had been extensively criticised (Dodd 1973, Ogier 1981, Orton 1981, Fretwell 1982, Bendall 1985, Judge 1985). The case for reform had been fuelled by concern about several issues in nurse training, namely educational standards, service delivery, recruitment and retention of students, changes in the National Health Service (NHS) and in the health needs of the population. Project 2000 was implemented to address the needs regarding educational standards identified in these reports and was aimed at preparing nurses to meet the health care needs of a changing society in the 1990s and beyond.

The structure of the new pathway included a foundation course and a branch programme that included time spent in practice placements where the students were of supernumerary status. The new training programme was to be of three years duration, of modular design and based on semesters. The structure of the programme was such that the student followed a health to illness continuum, with modules offered from health/nursing studies to include research methods and clinical skills, sociology, psychology and bioscience. Bioscience included pharmacology, pathophysiology, biochemistry, genetics and microbiology (Trnobranski 1993, MacNeil and Cavanagh 1995). This enhanced and more secure knowledge base was seen as vital in bringing about an increase in the confidence, skills and autonomy of nurses (White 1988, Cork 1987, Robinson 1991).

2.13 The development of the new programme in nursing education

With the rejection of the apprenticeship model of curriculum and implementation of Project 2000, the UKCC (1988) stated that if nurses were to meet the health care needs of the present and future society they needed analytical skills. Implicit within this statement was the belief that traditional methods of nurse education were no longer effective (Andrews and Jones 1996). There had to be a commitment to equip students with abilities to marshal information, and to assess, plan, implement and evaluate care in both institutional and community settings (UKCC 1988). A model of nursing education that was distinct from the objectives model which had featured so long in the nursing curriculum, should ensure that nursing education emphasised the underlying reasons for nursing tasks and other activities which related to patient care (Akinsanya 1987, Parker and Carlisle 1996). Ideally this model of nursing education had to assist the development of professional competence.

Professional competence was a complex construct. One element was a theoretical understanding of ideas that had been drawn from disciplines such as bioscience and taught in a manner that made clear their relevance for practical settings (Glen 1995). Competence was also linked to accountability for one's action in practice (Birchenall 1991, Eraut 1994). Increasing awareness of the public's right to know what was being done to them by health care professionals made it even more important that nurses understood what they were doing to patients and why. In addition to the importance of accountability was the idea of providing holistic patient care, which meant the education of any professional should involve an integration of all theory and practice in order that their professional knowledge is a hybrid of the two (Eraut 1985, Larson 1990).

Attempts at assisting students to integrate theory and practice mean concentrating on the content of the professional curriculum and involve three processes. According to Murphy (1993) these are:

- liberal education
- professional knowledge (to include elements of analytical thinking, clinical knowledge and skills, and understanding of the research process)
- internalisation of a value system

A new curriculum framework that included all three of the above educational elements would introduce two key changes: a re-examination of the different forms of knowledge, along with the teaching methods used, and a re-examination of the student-teacher relationship (Allen 1990, French and Cross 1992, Casey 1996). Suggestions for the new curriculum were influenced by the earlier studies of Heron (1981) who reported that three forms of professional knowledge do exist. They are:

- propositional knowledge, factual theory taught in the classroom
- practice knowledge, relating to skills in the delivery of nursing care
- experiential knowledge

All three types of knowledge need to be developed simultaneously in professional programmes if students are to become knowledgeable, competent practitioners. The old programmes in nursing only considered two aspects of professional knowledge acquisition, the propositional and the practice. Experiential knowledge, which involved critical reflection on clinical acts taken by ones-self and others, has been largely ignored (McCaughtery 1991, Dale 1994). The failure to develop this important third dimension of knowledge contributed to the emergence of a theory-practice gap. Nursing, like other health professional training, is a pragmatic course, not a purely theoretical course and as such needs the support of experiential knowledge to deliver patient care.

2.14 Approaches to teaching and learning in the new programme

Approaches to teaching and learning in the new programme were considered by nurse educationalists in conjunction with the new eclectic curriculum framework that accommodated all forms of knowledge for nursing. Organization of nursing knowledge was no longer to be based on the objectives model but on emancipatory theories more akin to constructivist, humanist and social theories (Clare 1993, Glen 1995, Casey 1996).

Constructivist theories were first promoted by Dewey (1933) followed by Piaget (1952), Brunner (1960) and Vygotsy (1986). Constructivists hold that meaningful learning occurs when people actively try to make sense of the situation in which they find themselves. The constructivist approach contains an element of problem solving mainly as the result of the views of Brunner. These theorists argue that much institutional learning is in the form of a step-by-step study of facts and theories that students can recall on cue, but that it is not meaningful for they are unable to use this learning outside the classroom. Attempts to promote independent learning in students accustomed to being taught by behaviourist methods have not always proved to be successful (Brunner 1960). Brunner argues that in order to achieve independent status students need to confront problems and to seek solutions to these problems by engaging in small group discussions. However, Brunner said of problem-solving that it is an inefficient method of learning on its own. Students would never discover how situations connect together, how previous knowledge is relevant, unless they work together in-groups to create a meaningful learning experience using knowledge from experience. Students need to learn how to learn if they are to develop the propensity to function as problem solvers (Brunner 1960) and such learning needs support until the student becomes competent. Variations of Constructivism, the cognitive form, focuses on student learning that takes place in the individual allowing them to form a new schema out of existing knowledge when presented with a new situation. Professional courses often promote this learning with the use of mentors or preceptors (Barlow 1991, Anforth 1992).

A second condition that Constructivists noted as being important for learning was that of learning in context. Duffy and Cunningham (1996) explain that this contributes to the ability to use relevant learnt material in the right setting. They argue that traditional forms of education are largely decontextualised since they are taught in the formal setting of the classroom or lecture theatre. Such knowledge is seen as inert by students, since it appears to them to have no relevance beyond the formal learning boundary.

The Humanist approach to learning arose out of the theories of Coombs (1965), Rogers (1967) and Maslow (1968). The central theme that emerged was that students taught in a Humanist framework would feel supported by the teaching environment in addition to feeling safe to learn and to fulfil their potential (Rogers 1983, Maslow 1987). A socially supportive environment allows students to feel positive about themselves and their learning, and to pay less attention to the cognitive aspects of learning. Their desire to know is the motivator.

The third approach to learning was identified by Johnson and Johnson (1995), Johnson *et al* (1994) and Johnson *et al* (1995). The ideas proposed by these theorists are that co-operative learning arrangements encourage inquiry, conflict resolution and sharing. This involves students working together and being motivated by a sense of obligation to a co-operative team effort. They identify the constituents of co-operation as:

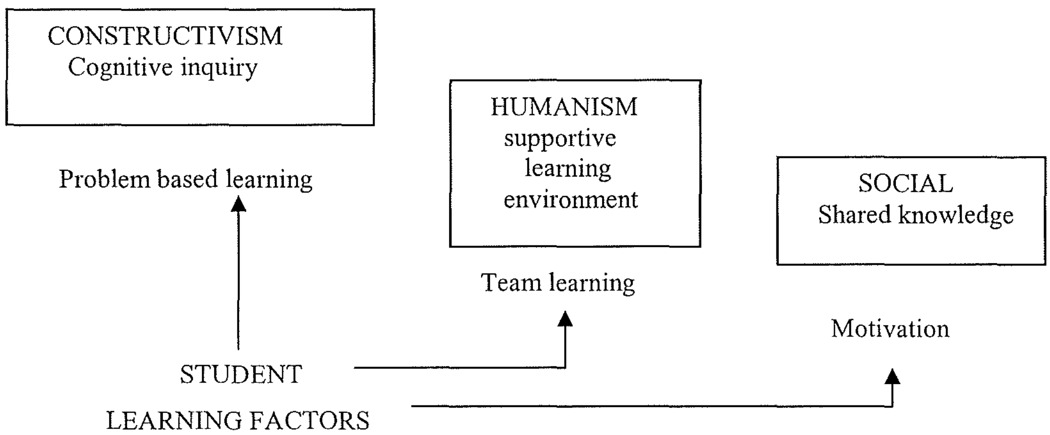
- group heterogeneity
- group goals
- promoting interaction
- individual accountability
- interpersonal skills

- equal opportunities for success
- team competition

Adapted from Snowman and Biehler (2000)

Co-operative learning approaches found support in the investigation by Qin et al (1995). They concluded that this type of learning had very positive effects on motivation and achievement of individual students and on social relationships. Qin and his colleagues (1995) noted that students who worked within a Social Approach framework solved more problems correctly than did others who worked alone. Co-operative learning appears to encourage the transfer of information between students.

Figure 1: Summary of emancipatory educational theories and the factors fostered for students' learning



2.15 Evaluations of the new nurse education programme

During the ten years, 1993-2003, since the implementation of Project 2000 and the initial evaluations, concerns regarding various aspects of the programme have continued to be raised (Hislop *et al* 1996, Parker and Carlisle 1996, Maben and Macleod-Clark 1997, Fulbrook *et al* 2000).

There are problem areas that concern fitness for practice. Staff and students in educational establishments sense that students are failing to tie the classroom theory to their clinical practice. In an attempt to find out more Fulbrook *et al* (2000) used a questionnaire to collect information concerning the beliefs of the students regarding their ability to apply theory to practice from two cohorts of students (n=92) over the period of one year. Both groups of students were on the new Project 2000 type training programme, the 1989 and the 1994 versions, with the second programme having been improved with respect to the integration of skills and practice. Fifty-five students from the 1989 programme responded while 39 students responded from the 1994 programme. The findings of the study emerged as five major themes. Of the themes identified, two dealt with the application of theory to practice. These were highlighted as being the most worrying to the students. Sixty five percent of the students (n=38) on the 1989 programme felt they were able to apply theory to practice while 72% (n=26) of the 1994 programme felt able to apply theory to practice. Statistically the difference between the two groups was reported as not being statistically significant and the study had many limitations. The data were collected from the students using a closed type questionnaire that asked the students to select their answer from one of four points on a Likert scale. The scale had been reduced from the more common five points to four in an attempt to force respondents to choose an option that would clearly indicate a positive or negative choice.

The majority of the responses obtained formed a tight cluster around the mid- value of the data range with some data in the positive end of the scale. The findings left the researchers undecided as to the final outcome of the study. It was concluded that if the students could not clearly select an option from the scale that was unreservedly positive or negative then there had to be a problem concerning their ability to apply theory to practice.

Hislop *et al* (1996) used semi-structured interviews to obtain information from a group of students undertaking a Project 2000 type training programme. This research team was especially interested in the finding out how students had applied the theory taught on the course to their practice within the clinical setting. Nineteen students were interviewed – qualitative approaches to the data collection having been chosen so as to gain in-depth insight into the issue. All the students were in their second year of training as that was felt to be a time when students would have a more settled perspective of the course.

The results reinforced the idea that learning needed the context of practice to make it meaningful and effective. More than half of the entire student group (n= 11) were critical of the educational establishment's attempts to link theory to practice. They made specific reference to the bioscience component of the programme. There was a need to situate theory and practice more closely within the context of the practice setting and this was lacking. Hislop had used a semi-structured approach to the interviews which allowed him to focus on the areas being discussed and to explore an issue with additional questioning if it was felt this would be useful. The final outcome of this approach can result in a more valid set of findings than questionnaires employing only closed items (Cohen and Manion 1989)

The difficulty of interpretation of the findings of these two studies lies partly in their small sample sizes. Hislop *et al* (1996) enrolled only 19 participants for his study. Respondents can be reluctant to provide full information and less than truthful remarks can lead to data that are not truly representative of the population under investigation. Fulbrook *et al* (2000) used a questionnaire on 92 students. Questionnaires, even those using items with an open ended format, tend to produce less data than interviews since students may decline to answer or misrepresent their true beliefs and there is no sure way that this can be detected and corrected. Small numbers enrolled via convenience sampling may be atypical of the main population, introducing bias into results (Politt and Hungler 1999). Fulbrook himself commented on the number of conflicting batches of results identified and on the fact that statistical analysis of his findings showed a skewed population.

Despite their limitations, these studies produced a common finding that the clinical placement was the preferred setting for the learning of theory that is valuable for practice. The findings of these studies are supportive of each other, and as such, some of the limitations identified in individual studies recede in importance. In an unrelated study one year after Fulbrook *at al,* Maben and Macleod-Clark (1997) also identified the academic/clinical mismatch and made particular reference to the bioscience component of the course. So despite the new design, implementation and evaluation of teaching strategies of the nurse training programme, the linking of theory and practice for students continues to be difficult.

This lack of definition in the syllabus generally was noted by nurse educators in the early nineties when the programme was reviewed prior to the implementation of Project 2000, and this review resulted in increased concern. A similar picture emerged when reviewing the curriculum with respect to the contribution of bioscience. From the field of nursing research only about a dozen contributors have attempted to address the place of bioscience in the education and the curriculum of the nurse and most of these studies have taken place since the 1990s after the new training was introduced (Karch & Kent 1990, Wynne *et al* 1997, Jordan and Potter1999, McKee 2002).

The most recent of these studies McKee (2002) examined the problem from a different perspective from previous research and sought to ascertain why students claimed to find this subject so difficult to learn. McKee (2002) hypothesised that the study of bioscience might be difficult because of a perception within the students' mind rather than the reorganisation of bioscience within the new programme of nurse education. The study involved two sample groups taken from two cohorts of typical students. The teaching of the subject was carried out using the methods of lectures (66% of the course material) and small group teaching (33%) half of the latter (15%) being spent in laboratory work. At the end of their first year the students were presented with a questionnaire and asked to reply to questions under the headings of study patterns, attendance, student educational profile, current work patterns, previous knowledge of bioscience. McKee (2002) also collected data obtained from exam results to supplement what the students provided in the questionnaire.

Eighty nine percentage (n =119) students responded. The results from the study suggested that many factors interfered with the ability of students to learn bioscience such as, poor study skills, and lack of motivation and limited previous knowledge. However the most likely reasons were an overburdened timetable and curriculum and the lack of strategies aimed at improving student motivation. McKee (2002) recommended that bioscience should be introduced slowly and become increasingly prominent throughout the programme and that it should be integrated with practice.

McKee's study is small and features one educational establishment a limitation that she herself acknowledges. This reduces the possibility of generalising her findings to other groups of students. Despite this, the study does confirm what earlier researchers (Nolan 1973, Wilson 1975) and now more recent researchers have pinpointed, that bioscience is a difficult subject for students and that the level and quantity of bioscience needed for the nursing course and appropriate teaching strategies to be used still remains largely undetermined.

2.16 Scientific thinking

In addition to the concerns surrounding the transfer of learning from theory to practice there was also the issue of how students viewed the whole subject of bioscience as opposed to the other subjects that they studied such as sociology, nursing theory and ethics. The difficulties of learning this subject have been consistent and persistent over the last thirty years and this raises the question that it might be the nature of the subject itself.

Bioscience has been defined in the beginning of this study as a mix of science subjects that is especially pertinent to providing an understanding of human phenomena (Wilson 1975, Akinsanya 1987). In order to understand the phenomena and procedures of bioscience as seen in the practice context they have to think about them scientifically. *Scientific thinking is not natural thinking* (Matthews 1994, p28). People do not spontaneously develop it.

Scientific thinking needs to be learnt and this involves initiation into different ways of thinking about phenomena if scientific thinking is to happen (Wolpert 1992). Kempa and Hodgson (1976) claim that the development of scientific thinking progresses through a sequence of four phases. In order to progress the student is required to modify continuously his/her own perception of the concept his/her is learning and bring it to an increasingly higher level of abstraction. If the student cannot do this he/she is unable to attend satisfactorily to problem solving tasks commonly used in science and will employ immature techniques. This inability of the student is a failure on his part to adjust to the type of concept attributes that are necessary for problem solving but it does not mean that he is not intellectually unable just that he cannot adjust to the concept attributes demanded of him by science.

Scientific thinking is based on empiricism which accepts sensory experience as a source of observable knowledge and that reasoning about the information that had been observed allows the gaining and testing of knowledge of our understanding of the world (Mathews 1994, Savin-Baden 2004). Newble and Clark (1986) and Biggs (1987) describe science students as being fundamentally different from other students. Biggs' study used 464 students in higher education and the cohort was equally divided into arts students and those studying science such as chemistry and biology. He used a study behaviour questionnaire and asked the question do arts and science students differ in their approach to learning. The findings indicated that the ways the arts students adopted were indeed different from those students who studied science. Biggs' described science students as being more interested in content mastery. There was a preoccupation with understanding of scientific concepts. This learning progressed in stages and took varying lengths of time for different students to achieve. The arts students in contrast used approaches that involved reproduction and transformation. This involved applying the written word to other concepts and rearranging their meaning to bring about a different understanding of an issue. This activity could be called a synthesis using the definition proposed by Bloom (1955) and in terms of taxonomy is a higher level intellectual activity. This was not an activity that science students were found to have used as frequently as the arts students. However, Biggs recognised that different faculties had different techniques of teaching and this could have affected how the subject was learned by students. He felt that this possibility could not be ruled out and it could be argued that this, along with the fact that he looked at student learning in only one educational establishment are limitations of his study. Nevertheless all student learning has been shown to be dependent on a number of factors that are categorised as contextual and individual to the learner. Contextual factors include teaching/learning activities, assessment, institutional values (Ramsden 1992, Watkins and Biggs 1996, Dart and Boulton-Lewis 1998, Biggs 1999, Prosser and Trigwell 1999). Individual factors include the perception of the learning, task difficulty and workload demands. Much of the research into student learning identifies it as dynamic and amenable to change (Trigwell and Prosser 1991, Gibbs 1992). However there have also been many reports of a division in science learning by the students into what has been described and deep and surface learning (Newble and Entwhistle 1986, Watkins and Biggs 1996, Prosser and Trigwell 1999). Prosser and Trigwell (1999) suggest that this consistent reliance on surface learning as opposed to deeper learning may be the result of how much factual material has to be absorbed in order to understand the science hence memorisation becomes more appropriate and a less demanding study strategy which allows students to keep up with their studies.

Studies of how science and scientific method are used in health care have identified that reasoning from data to solution (forward reasoning) or from solution to data (backward reasoning) are the basis of practitioner expertise (Patel *et al* 1995, Andrews and Jones 1996, Norman and Schmidt 2000) Such abilities are also the abilities that are needed to solve problems (Foley *et al* 1997, Savin-Baden 2004). Clinical nursing is not the end product of a theoretical programme but is part of a programme that incorporates experience. Experience explores patient/client situations in the health care settings and asks practitioners to apply bioscience concepts to the generation of hypotheses to explain what has been seen, look for alternative solutions and develop appropriate nursing diagnoses and interventions. This sort of activity takes place every day within a clinical placement setting and forces students to develop more creative aspects of learning and to integrate theory and practice if they are to become competent practitioners. Students have to use bioscience theories in order to make decisions concerning patient interventions and this imposes upon them the necessity to develop a learning style that is a more scientific and problem based and to discard previous learning strategies.

2.17 Problem based learning

During the last decade problem-based learning (PBL) has generated considerable interest as a teaching strategy especially with respect to its strengths and weaknesses compared with conventional instruction. Problem-based learning or problem-solving is underpinned by a constructivist perspective (Savery and Duffy 1995). The constructivist's view of learning claims that meaningful learning occurs when existing knowledge is used to create new knowledge frameworks. Brunner (1960) proposed that this could be achieved by giving students realistic problems which they could use as starting point and which would end in the finding of a solution. Problems are of three types: well-structured, ill-structured or issues (Snowman and Biehler 2000). They claim well-structured problems are clearly formulated and solved by a clear procedure The result is a solution that meets a well-known standard. Ill-structured problems are more complex and may have several methods that allow the reaching of a solution but whether that solution is definitive is in itself uncertain. Sometimes *problems* are not problems but *issues* for which there is no solution but the need to find a reasonable position. Many of the difficulties encountered in a healthcare setting fall into this last category. Despite the differences to be found in the types of problems, research suggests that there is a general approach to problem-solving that is used by all (Bransford and Stein 1993, Gagne *et al* 1993, Nickerson, 1994). This approach consists of five steps.

Figure 2: The problem based learning cycle

- Realise that the problem exists
- Understand the nature of the problem
- Compile relevant information
- Formulate and carry out a solution
- Evaluate the solution

Adapted from Snowman and Biehler (2000)

This perspective sees knowledge as something that the student has to build for himself (Blais 1988). Students construct a framework that represents their understanding of a setting or theory. Sometimes a student's understanding is not correct or incorrect (Blais 1988) but it was the only way the student can understand their experiences in contrast to their taught theory. The creation of more than one framework results in the recognition of similarity, with the consequence that learning is transferred. The transfer of learning may take two forms: the form of low road to high road (Saloman and Perkins 1989). Low road transfer is defined as a situation in which a previously learned skill is automatically retrieved from memory and applied to a similar situation. Following a period of intense practice in different settings using different equipment, the idea of what the previously learned skill could mean begins to be formulated, using controlled and conscious thought. It is this mindful abstraction which Salomon and Perkins (1989) claim is the basis of learning being transferred from a low to a high level. It is intended that initial low road learning will become high road when a problem-solving approach is used because the development of understanding requires the integration of theory and practice in a contextual setting and this in turn requires collaboration between educationalists and practitioners (Eraut 1994).

During the 1960s PBL was used by Barrows in an attempt to develop the skills and knowledge of medical students learning how to manage clinical situations. He used problems such as posed questions, unexplained phenomena, short case vignettes or complete case studies and it was while using problems to teach students that he became aware that using different types of problems achieved different educational outcomes. Barrows felt that most educationalists failed to perceive the difference and chose to use the type of problem that they saw as favourable or economic. As a consequence they sacrificed educational achievement in their students. In response to this recognition Barrows (1986) sought to categorise problems into six different types, each one capable to a greater or lesser extent of developing the ability of the student to learn. The most highly rated of the levels is that which involves the use of the closed loop, the reiterative problem-based method. Here students are asked to return to the original problem, re-evaluate the information that they used to solve the problem initially and see if they could do better the second time round now they have more understanding than before.

Figure 3: Barrows' hierarchy of problems

Increasing complexity

Lecture- based cases
Case-based lectures
Case method
Modified case-based
Problem- based
Closed-loop problem-based

Adapted from Barrows (1986)

Despite the intense interest to date there has been no conclusive evidence that problem-based learning is a better method of teaching (Kaufman and Mann 1997, Foley *et al* 1997, Albanese 2000, Finucane and Nair 2003). Norman and Schmidt (1992) had earlier reviewed the experimental evidence surrounding the possible differences in students learning following a problem-solving approach and the traditional didactic methods. What problem-based learning achieved, that didactic methods did not was an enhancement of the student's intrinsic interest and the maintenance of their self-directed learning skills. Learning resulted in the establishment of internal states that influenced the learner's choice of personal action (Gagne 1985). These outcomes were referred to as attitudes. Attitudes persisted over time and were amenable to change. They formed predispositions within the student to respond in a certain manner. If students employed such attitudes to their learning, in this case that of bioscience, they would have seen the subject as interesting and relevant to their professional needs and this in turn would act as motivator for learning (Norman and Schmidt 1992, Kaufman and Mann 1997, Paganus 2001). Despite claims for increased motivation for learning Barrows expressed reservations that this would always result since the choice of problems used by the teacher was likely to compromise students' learning.

2.18 Experiences of using PBL programmes

Despite reservations relating to problem-based learning, since 1992, several medical schools within the UK have moved towards programmes that encouraged student-centred learning, small group teaching and problem solving. These programmes were in Manchester, Newcastle upon Tyne and Dundee Universities (Harden *et al* 1997, O'Neill 2000, Dammers *et al* 2001). All the centres had implemented new programmes, but the common factor for all of them was the inclusion of problem-based learning (PBL) for part of the course and involved aspects of applied bioscience. Using Barrows' framework of what constituted problem solving the following conclusions were drawn.

None of the establishments reporting on the use of PBL employed Barrows' approaches. Newcastle in the UK came the closest with the use of problem-based learning that began with the patient's presentation, while Manchester did use the case based method but restricted its study to the effects of PBL for the learning of anatomy. Dundee claimed to use PBL but did not specify whether the type of problem arose from the lecture, the clinical task or the patient. The variations in the type of PBL implemented and reported on by the centres means the outcomes of learning using a problem base will be so different as not to be comparable. Manchester and Newcastle also became aware of another difficulty in that some of some of the teachers were unable to work in a facilitative manner with the students. Manchester also expressed concerns relating to the ability of the teachers to integrate bioscience into problem-based learning methods that used patients as the source of problems.

Despite these criticisms Dammers *et al* (2001) in a separate study, concluded that the use of patients in problem-solving had a very real motivating effect on the student and potentiated learning. Therefore using a patient-based problem should result in a greater learning achievement than using a hypothetical case or a lecture-based problem which Barrows himself rates as being less able to promote learning. Although students did appear to learn more, the conventional approaches used to assess learning did not seem to be able to identify all the learning achieved by PBL methods. It seemed that the assessment of the learning achievements of students taught using this approach needs to be estimated using a different and as yet unidentified strategy.

Criticisms have also begun to emerge from those who have experienced using this learning approach. A recent paper by Dolmans et al (2001) identified that problem-based learning had negative effects on students leading to ritual behaviour and the discouragement of participation in tutorial groups. Dolman's criticism arose out of the use of problem-based learning in medical education in the Netherlands. Her writings were based on her experience and that of her colleagues. There are no details of the method used to collect the data in this study but analysis of the data led them to identify negative group behaviours amongst students, which were labelled as dysfunctional. Two especially negative group behaviours were identified namely ritual behaviour and dysfunctional tutorial group behaviour.

Ritual behaviour was defined as behaviour in which the student did not become actively involved in the group learning but gave the appearance of having done so. Examples of this were recorded when the student group divided the work into sections, and often read each section separately without individuals providing linkage to the other sections after studying their section in isolation.

Dysfunctional tutorial group behaviour was recognised when some members of the tutorial came to the tutorial unprepared to contribute to the topic. Some students did not even bother to attend at all. As a consequence previously motivated members began to contribute less and less to the tutorial group activities. Instead of being a cohesive learning unit the atmosphere began to be that of *social loafing* (Dolmans 2001).

Tutors confronted by such negative behaviour tended to correct these difficulties by taking control of student learning. They became objective, using teacher directed approaches to learning. This in turn brought about the deterioration of student-directed learning and conflicted with the intentions and philosophy of problem-based learning. It appeared that problem-based learning as a positive method of teaching was only going to succeed if the teachers using such methods were experienced and knowledgeable with respect to educational theories. Problem-based learning needed the stimulation of the group by the problems used and the skills of the tutor.

A more recent study by Finuccone and Nair (2002) detailed how problem-based learning contained an inherent flaw which existed in the case studies. Samples of problem-based learning case studies were examined from the fifth year and the fourth year of undergraduate medical training programmes. Thirty eight per cent of the cases out of a total of (n= 162) were based on rapidly resolving clinical problems. This gave the students the impression that illness problems were short term and solvable, which is often not the case in reality. It appeared that problem-based learning could benefit from the use of complex problems more in touch with the health care needs of a population that, for the western world at least, was an aging population. Solvable problems that provided closure of learning and reassurance to students did not promote long term learning and defeated the intended outcomes for problem-based learning. However they have provided a basis for further exploration and as a scholarly activity, appeared to have a value in promoting the students' ability to analyse, synthesise and evaluate material.

Despite these reservations concerning PBL, other professional courses such as physiotherapy are continuing to show an interest in using this approach to learning in conjunction with the use of an integrated curriculum (Morris 2003). Health professionals in Occupational Therapy have spent time examining methods of teaching students how to be inquiring in the assessment of their clients (Neistadt 1992, Sadlo 1994). Neistadt's study specifically looked at the acquisition of clinical reasoning skills in students. Clinical reasoning had been defined *as a dynamic process of inquiry in action that takes place in the context of the occupational therapy evaluation and treatment* (Tufts University-Boston School of Occupational Therapy 1990 p3). Students were taught this skill by being involved in a classroom-as-clinic learning situation. During these sessions they would identify a client's problem, which they then used as the basis for therapeutic planning. This sort of inquiry equates with Rogers' definition of problem-based learning. Although this method of teaching appeared to begin the development of clinical reasoning and problem-solving, critics argued it was unable to foster the complex array of reasoning skills that occupational therapists had to be able to use in practice and as such did not adequately equip students for the challenges of practice (Cohn 1991, Schwartz 1991).

Despite favourable opinions concerning PBL and its potential value as a health professional's curriculum framework, there are critics of this method. Friedson (1971) commented of problem-solving that it was sometimes rigid and blocked the potential professional from seeing an event in the many different ways that it presented in practice. He suggested that problem-solving assumed that there would be an answer to the problem but answers were not always achievable in the professional setting. There is no firm data to date to support Friedson's concerns but a problem-solving approach to the learning of bioscience appears to promote students' learning. There is an indication from Friedson's research that the clinical practice setting could also be influencing a positive learning outcome in biosciences to a greater degree than had previously been recognised.

Further support for Friedson's statements was found in a commentary by Sen Gupta (2001) concerning medical students and problem-solving. Sen Gupta argues that the community setting where the patients are should be the centre of student learning. The opportunity to form relationships with patients results in a deeper understanding about patients' illnesses and consequently a deeper understanding of the bioscience involved. Students chose to learn for themselves because of the relationship that the student builds with the patient. The conclusion of the paper is that more data and more debate are needed about the issue of curriculum development, teaching strategies using PBL and the learning of bioscience.

PBL is a relatively new method of teaching and learning and to date not enough studies into the effect of problem-based learning or problem-based teaching could be found to support or refute these observations and accounts. However the available studies do point to weaknesses and issues within PBL that may make this method of learning no more desirable than any other method. Much more research has to be done into the use of PBL before its full effect in assisting professional learning can be seen and evaluated (Patel *et al* 1991, Albanese and Mitchell 1993, Colliver 2000, Morris 2003).

2.19 The student-teacher relationship

Much of the research examined to date makes reference to the teacher of bioscience and their relationship with their students. Knowles (1990) rated student nurses as adult learners and therefore most likely to have the characteristics common to adult learners. He saw those characteristics as:

- self directedness
- having prior life experiences
- having a readiness to learn
- having a problem solving orientation

Adopted from Knowles (1990)

He suggested that student nurses would be best taught using an androgogical approach, thus breaking the more formal teacher-centred relationship of the old objectives model curriculum. He proposed three important guidelines for the teaching of adults:

- adults need to learn what is useful to them
- learning affects an adult's self concept
- an adult's life experience can be used as a source of new learning

By focusing on students' knowledge, needs and feelings about learning and the content of learning, the teacher is placed in the role of facilitator rather than a source of knowledge. Such a positional change between teacher and student is said to encourage emancipatory learning (Bevis and Murray 1990, Slevin and Lavery 1991, Casey 1996) and the best way to ensure this change takes place is to encourage an active role for the learner.

Support for Knowles' idea of the nurse being an adult learner came from Kolb (1984). Kolb believes all learning to be a form of problem-solving and identifies a close relationship between how students learn and the ways in which they achieve their learning. How an individual copes with learning involves motivation, approaches to teaching, previous education and the context of learning. All of these combined together form a learning strategy. Rampogus (1988) saw a students' learning strategies as parts of a whole that when combined produced an individual's learning style. Following his research into the learning styles of student nurses, he claimed that students often displayed multiple learning styles that varied according to the learning task being undertaken. This is considered to be advantageous for practice since practice often requires that the practitioner be creative and this creativity is most likely to be fostered when the student makes use of different styles of learning at different times. An openness to alternatives and the acquisition of scepticism could be fostered by teachers who assume the role of a supporter for learning as opposed to that of being the controller of learning (McMillan and Dwyer 1989, Andrews and Jones 1996). The quality of flexibility was seen as useful in problem solving.

It seemed that treating nursing students as adult learners would permit students to develop learning strategies that could increase the chance that students would employ their problem-solving skills in the practice setting as well as the educational setting and this should lead to integration of theory with practice (Andrews and Jones 1996). Such an action-orientated approach to learning favours the development of critical thinking because it conveys the belief that the future is open and malleable and waiting to be acted upon (Bandman and Bandman 1995, McAllister 2001). Bandman and Bandman (1995) also see this as a way of developing critical thinking, a quality that would be useful in areas such as health care, which is continually changing. This could positively contribute to solving some of the critical problems of health care for a nation for in the long run it would be the ability to solve problems collectively that could prove to be the most important.

However the work of Zeegers (2003) casts some doubt on the ability of the mature student to become an adept problem solver and bioscience learner with the ease described by Knowles. Zeeger's study was carried out on 200 first year science students over a three year period and was a prospective study. The study focused on the learning styles of students undertaking a first degree and sought to identify the factors that influenced change to their learning. The older learner was identified as having an elaborate learning style and being more committed to their studies but was also seen to be influenced by the learning strategies they had used in the past. Many of the students saw university education as a continuum of the secondary school and resisted pressure to alter their learning style which often supported surface learning. Zeegers questioned whether it was these students who eventually went on to become the attrition group, something that is of concern to all universities at the present time, or whether learning styles were provoked by the university's teaching learning and assessment strategies which are often based on didactic learning outcomes, multiple testing and theory. These practices may be reminiscent to the student of their secondary education experiences and encourage the student to rely on strategic study strategies that they have successfully tried and tested before rather than risk changing their learning style.

These findings should be of cause for concern for the diploma of nursing programme for students on the current programmes number approximately 600 students per annum. With such large numbers and a large student to staff ratio it is difficult to enhance the learning of students that the teacher never has time to get to know. Despite new government initiatives requesting that all university students undertake a key skills module which includes the identification of their learning style there is no evidence that this information has resulted in any positive changes on the part of the student to approach their learning in a more useful way.

2. 20 Rationale for the present study

The literature prior to the 1990s and the introduction of the project 2000 type training, and in the years afterwards from 1990 to the present day, show that difficulties relating to how much bioscience should be taught, who should teach it, how should it be taught and the lack of educational research are questions which are still being repeatedly asked.

In addition bioscience needs to be applied to the practice of patient care since the knowledge needed to solve many problems in clinical care is at least partly dependent on a knowledge of this subject (Akinsanya 1987, Jordan 1994, Casey 1996, Jordan and Reid 1997, McVicar and Clancy 2001). Educational and political influences in this last decade have resulted in a reclassification and a reframing of health professional curricula but there still appears to be little consensus as to how bioscience should be taught to enable it to support practice (Wharrad *et al* 1994, Jordan 1999). Added to this there is a lack of research- based evidence to guide curriculum planners in deciding the bioscience content of courses (Chandler 1991, Parry 1991, Frazer 1991). In higher education more than half the nursing courses still use the lecture method to impart knowledge of bioscience despite suggestions in the literature that this is not the most effective method for teaching this subject

(Chandler 1991, Rolfe 1993, Sinclair and Gardener 1997, Brown and Atkins 1998, Davies *et al* 2000). Consideration of the position of bioscience in other health professional programmes especially medicine reveals a similar situation.

The need to find a strategy for the teaching of bioscience that will also inform practice still exists and appears to be more pressing than ever. Therefore the aims of this study were to focus on:

- attempting to discover the process by which students came to understand the bioscience that they encountered in clinical practice and the factors that promoted the development of this process.

- proposing that the information gained be used to inform the development of a teaching strategy that will promote the learning of bioscience for health care professionals undertaking their basic training.

CHAPTER 3
METHODS

3.0 Introduction

A review of the literature has revealed that the subject of bioscience has proved difficult to learn for students on health professional programmes. The few former researchers identified bioscience within the medical and nursing curriculum as ill defined in relation to how much students should learn, how it should be taught, who should teach it using which strategies. For students of nursing one of the biggest difficulties is how to comprehend this subject so that it helps them to understand what is happening to their patients.

Bioscience has two aspects, the normal and the pathological The bioscience that students learn in the educational setting is based on normality and although there may be reference made to the reality of placement it does not expose them to the pathological variation that they meet in real practice. Somehow the students have to overcome this difficulty to enable them to make decisions that will enable patients to cope with their pathology and its outcomes. To begin this process students must be able to recognise the pathological as an aspect of bioscience and to be aware that decisions about patients' care are linked to understanding this subject. In my experience most students complete their training and are rated as competent practitioners and able to make decisions about patient therapeutics independently. The implication is that they are able to do this because they can use their bioscience knowledge. If they did not learn bioscience within the educational setting in a way that informed their practice then where did they learn it and what were the processes that they used that allowed them to attain meaningful learning. In order to reach an understanding of how this came about it was deemed necessary to explore the initial general aim declared at the end of the literature review from three aspects. Firstly to identify the students' perception of a bioscience within that setting. Secondly to discover which strategies the student used to reach an understanding of bioscience that was encountered therein and thirdly to confine the data collection to the clinical setting of the student as this was were the student spent an equal amount of their course learning hours

3.1 Action research

Action research was the technique used to investigate the aims of this study. Action research attempts to bring about change by auditing a situation and critically analysing outcomes. It is reflective and critical and is said to allow action to be taken following the identification of problems (Bowling 2000). Lewin (1946) from whom the idea of action research first originated identifies three clear stages. They are:

- Analysis of the situation prior to the fact finding.
- The instigation of an event designed to bring about a change.
- Evaluation of the situation after the change.

Other descriptions of action research arose out of its use by social scientists. Two stages are identified by Blum (1959), a Diagnostic stage in which problems are explored and hypotheses developed and a Therapeutic stage in which the hypotheses are tested by a consciously directed change agent in a contextual setting. Meyer (1993) expanded the two stage idea and claimed that action research utilises six stages which are identified as:

- negotiation
- assessment
- planning
- action
- evaluation
- withdrawal

However since action research is a dynamic process all Meyer's stages are not necessarily discreet and have a tendency to blend into one another, but the three distinct basic steps identified by Lewin remain.

Action research is also stated to be different from other research because it is problem based, deals with individuals in a contextual setting, seeks improvement and change and is cyclical (Hart and Bond 1995). The cyclical element involves a process in which research, action and evaluation are interlinked. The spiral of theory and reflective practice achieves closeness to the reality of other people's experience and in the process increases the potential for creating an effective educational programme (Stringer 1996).

Stevens *et al* (1993) and Rogers (1985) argue there is a need to recognise that other methods of inquiry may be more important in developing knowledge within professions that are essentially humanistic and it is not necessary to reject other approaches such as positivistic approaches in order to undertake research involving the caring professions. This idea is supported by Schon (1983) who writes of social systems such as professional practice as being a mix of *high hard ground* and *swampy lowland*. Problems within the high hard ground can be answered by the use of classical positivistic approaches since they are clear cut, but problems from within the swampy lowland are inadequately answered by these approaches and new ways have to be found and used otherwise important questions from within practice remain unsolved. Schon suggests that the questions arising from the swampy lowland of practice are often of greater consequence than those from the high hard ground and this implies a greater pressure on researchers to adapt the most informative fact finding strategy.

3.2 Rationale for using action research

Nursing knowledge has traditionally been examined by research approaches based on positivist, interpretative or phenomenological philosophies (Rampogus 2002). Such approaches tend to consider the collection of data that can be measured, counted and expressed as a single piece of analysis as appropriate to explain the teaching of nursing and its practice. On reflection it would appear that such approaches have a tendency to focus on controlling in order to achieve an understanding of what is happening. It is possible that resorting to such empirical approaches interferes with the understanding of the experience of learning bioscience for nursing practice and this is what has made bioscience appear a difficult subject to learn and to teach. Researching learning for this subject may be better served by not attempting to seek out the truth using a controlled data collection method but to study patient care through informed practice achieved through learning which adopts particular approaches that increase the understanding of the subject as it is carried out in the practice setting. Benner and Wrubel as long ago as (1989) argued that narrow approaches to understanding excluded contextual and clinical knowledge and by their exclusion there was a failure to connect and learn form patients in the clinical setting with the result that that the knowledge base needed for practice was not fully mapped out. (Lewin 1946, Greenwood 1994, Bowling 2000) suggest that social systems in the real world that seek to achieve change can benefit from the use of action research technique since it allows phenomena to be studied in their real setting. Action research has been extensively used in education settings as a means of developing new and effective teaching strategies by encouraging reflection on practice. As such if offers a practical alternative to theory based research and allows participants to become engaged in defining problems, implementing solutions and evaluating them (McNiff 1988, Williamson and Prossser 2002). Obtaining as complete a picture of the study context and the participants as possible is crucial in the process of change and is essential in action research, but can also be a vehicle for generating new knowledge grounded in the reality of clinical practice (Nolan and Grant 1993, Waterman *et al* 1995, Walters and East 2001). Following these considerations it seemed appropriate that the approach chosen to investigate this problem should be one that viewed the problem in practice, tracked how it resolved itself and identified the process used to achieve resolution so that they could be used to inform the future teaching of bioscience.

Action research tends to use multiple research methods most of which are qualitative (Bowling 2000, McNiff 2003). Qualitative research is focused on understanding events in a social setting and takes an interpretative, naturalistic approach (Jones and Hunter 1995, Polit and Beck 2004). Events are considered in their natural settings and the investigation centres on phenomena in terms of the meanings that people give to them (Polgar and Thomas 1998). Polit and Beck (2004) point out that qualitative studies tend to be intensive rather than extensive and serve to achieve an understanding of the whole event studied They detail five stages that must be undertaken in qualitative research. These are: identifying the setting, gaining access to the setting, assuming an appropriate role, collecting and dealing with the data, and fulfilling the commitment made to the persons who provide access to the setting in the first place.

Bioscience theory is used and learned by students in a clinical setting. As the clinical placement is where the students need to be able to use bioscience for practice, it seemed appropriate to seek that information from within the setting where the ability to understand and apply bioscience is most demanded. Since qualitative research methods provide both flexibility and the opportunity to study and interpret learning within its contextual setting, a qualitative approach was considered the most appropriate method for the data collection part for this study.

In qualitative research emphasis is put on the researcher adopting a role that will allow him or her rather than using technical apparatus to become the main instrument in the data collection. This involves the researcher blending into the everyday routine of the setting and, in this instance, not being a hindrance to the placement. The result of this should be to make these studies highly realistic. Polit and Beck (2004) claim that using a true setting for the data collection is most likely to allow the outcomes of the study to be realised and demonstrates a commitment on the part of the researcher to achieve the aims of the study.

Qualitative data are collected in the narrative and acquired through a range of techniques such as interviewing or consensus methods (Bowling 2000). There is tendency for these studies to shift and become more focused in the course of the data collection and this can be assisted by a pilot study. Glaser and Strauss (1967) and Bowling (2000) say this freedom to shift should be seen as a positive quality. They argue that qualitative research more often generates hypotheses while quantitative research is more concerned with testing them. This means that the aim of the study should not be assigned too rigidly or the information being sought could be lost. Hence a hypothesis was not set since a hypothesis predicts a possible solution and implies that there is a relationship between variables (Polit and Beck 2004, Bowling 2000). The variables in this study would have been the students and the clinical setting but it was not certain that the two were connected in any way that brought about the learning of bioscience for practice. Even if it did the processes involved were still unknown. As no other studies have been published to date that addressed this question there was no previously determined starting point to act as a guide. The aim of the present study was therefore to discover the underlying dimensions and relationships that would shed light on the ways that students' used to learn bioscience in professional practice. It was important that this study should have a degree of flexibility in order that the early findings could determine the final focus and so the research question remained a broad aim.

To address the aim of the study Lewin's three stage approach to action research was chosen and three qualitative methods of data collection were used initially as part of the assessment stage of the research. They were the Nominal Group Technique (NGT), Interviews (I) and Critical Incidents (CI). Before describing each method and its use it is necessary to describe the population on whom they were applied.

3.3 The Diploma in Nursing programme

The Diploma in Nursing programme was introduced at the Royal Free Hospital in 1992 when the School of Nursing was integrated into Middlesex University. The Royal Free School of Nursing is a long established centre for nurse training dating back to the late 1800s and was recognized as one of the major teaching hospitals in London and the UK. The teaching staff within the school were expected to be qualified to a high level and the majority had completed pre-registration training there also. There was a sense of *belongingness* and a desire to maintain not only the high standard of nurse training but their place as one of highest rated hospitals in the capital. Such establishments often set their own criteria for admission to their schools and favoured certain types of students over others. They were often seen as difficult to gain admission to and therefore esteemed. Throughout the UK in all the capital cities there were similar establishments in the form of major teaching hospitals. At the start of the 1990s with the introduction of the new training programme known as project 2000, the Royal Free along with three other major teaching hospitals merged with Middlesex University. From this time onwards students were taught within the University campuses and attended clinical placement in one or other of the hospital sites. The exclusive relationship that the Royal Free had with nurse training had been broken.

The changes that occurred to the Royal Free Hospital School of Nursing were not exclusive to it. Throughout the country all the major teaching hospitals were undergoing similar changes. The training programmes were now controlled by the University rather than the hospital and they set themselves new academic levels based on the University standards. The students on this study were now typical of students in training anywhere else in the UK and this meant that the findings of this study could be generalised to a high degree. The choice of the Royal Free Hospital student was seen as an advantage to the study while another advantage was that of the new programme which had an intake of students twice a year and student numbers totaling 500-600 per annum. This created not only a large sample population but a large number of placements where students could be accessed. Both these factors would help to reduce the influence of bias that is ascribed to sampling from a small population. The final reason for choosing the Middlessex University students on placement at the Royal Free Hospital was simply because the researcher worked there as a newly appointed member of the teaching staff and also had a background in clinical nursing. The issues raised by the research had developed over many years and arose from experiences of nursing students in placement. However this was the researcher's first teaching post and the first time that the subject of bioscience learning had been seen from an educator's perspective. A new dimension of understanding of the subject had been opened but it had also raised other questions This was perceived as a most suitable programme to begin the research with.

There were some disadvantages to the choice of the Royal Free students participating in the study and that was the likelihood that a cities' student population was more likely to be made up of a larger number of overseas students than would be found in more provincial establishments. This could alter the findings and distort the study outcomes so that they would not reflect what is happening in other similar centres so making the results less generalisable. Despite this possibility the Royal Free Hospital students were still rated as similar enough to those throughout the country and they were available in large numbers. These factors overshadowed the negative aspects of the research context.

In addition to meeting the general academic standards of the university, the Royal Free programme met the standards required for the different parts of the professional register of the United Kingdom Council for Nursing (UKCC) and the Nursing Midwifery and Health Visiting Statutory outcome rule (1988).

The Diploma in Nursing is a three-year programme of study that enables the student to become eligible for registration as a practicing professional on successful completion of the course requirements. The programme comprises a one-year common foundation programme and a two-year branch programme. The branch programme has three branches, adult, mental health and child. Seventy per cent of the total student intake to the first year in this University choose to follow the adult branch programme once they have successfully completed the foundation programme. This pattern of students showing a greater preference for the adult branch compared with either the child or the mental health branches is common in other Diploma programmes throughout the UK universities (UKCC 2003).

The pre-registration framework is comprised of modules that are studied in semesters. The students are obliged to undertake three modules per semester of full-time study. Clinical practice placements are integrated throughout the programme. The clinical placements are in a variety of settings in both hospital and the community, providing students with experience of learning about patients or clients who have varying degrees of dependency and disorder. Clinical placements begin within six weeks of the commencement of the programme and vary in duration between four and eight weeks.

The study of bioscience is compulsory for all students in the foundation programme and is taught in both semesters. Semester one focuses on the anatomy and physiology of cell structure, tissues and the arrangement of body systems, including integration of chemistry and genetics. The structure and function of body systems is studied in semester two with an emphasis on homeostasis. Throughout the foundation programme the focus is on the healthy individual, with only a brief reference to the effect of disordered health on body systems and their function. In addition to providing a fundamental knowledge of normal human anatomy and physiology the modules are taught in conjunction with applied skills such as the measurement of blood pressure and temperature, and universal precautions in relation to infection control.

In the second year of their programme the Diploma students begin to consider the effect of disease processes and how these bring about disorder of homeostatic function. The third year of the programme does not include any study of bioscience in either health or disease. Here the emphasis is on the management of care and clinical decision making using the knowledge assumed to have been acquired in preceding years of study

3.4 Methods used in teaching and learning bioscience

Traditional methods continue to be used for the teaching of bioscience. Lectures are used for the giving of information. Such core sessions are supplemented with other teaching strategies that include:

Skills for practice. This includes such skills as the measurement of blood pressure, the interpretation of urinalysis and the estimation of pulse. These are taught and practiced initially in the safe environments of the skills laboratories rather than in clinical placements.

Computer assisted learning packages. These are a mixture of objective type questions and interactive activities focusing on the exploration of the human body and its systems. They are mostly designed by publishers to illustrate normal human physiological principles, although some of the body functions have been adapted to allow exploration of system abnormalities such as incontinence in relation to renal function.

The University in which the study was undertaken is committed to assisting the student to become an autonomous learner within the health care setting. In order to achieve this, study skills are taught in semester one of the programme. A greater variety of approaches to teaching are employed in other parts of the course but for bioscience only the three above-mentioned methods are used.

3.5 Study population

The students involved in this study were enrolled on the foundation programme of the Diploma in Nursing. The annual student intake was approximately 500 with sixty percent being female. This is in keeping with the nursing recruitment gender profile seen in nursing recruitment in the UK at this time. Forty percent of the students in the study population were from the indigenous UK population, thirty per cent from the Irish Republic and 30% were of African origin. All the students had 'O' levels/GCSEs or their equivalent in English, mathematics, and either biology or science in addition to other 'O' levels/GCSEs. Many students had 'A' levels/GCSEs or an equivalent in the social sciences and a small number had degrees in subject areas other than health. The age range of the group was from 18-35 years, with a mean age of 25 years. Three hundred out of the total student intake had had work experience prior to beginning the course. The work experience, which varied from between one and ten years, had not always been in the health field.

3.5.1 Sample population

Ninety-four students from the original student population formed the sample group for data accumulated over a period of two semesters during 1999-2000. They became part of this study because they were allocated to specific placements during the year in which the data collection was taking place. Students were either in the first year 35% (n=33), in the second year 32% (n=30) or third year 32% (n=30) of training, and no student was allocated more than once to any of the participating placements.

Students were randomly assigned to placements by the central student allocation office that had not been involved in any aspect of this study. The primary function of the student office is to oversee the student's training programme by making certain that all students experience a basic variety of placements and fulfil a minimum number of practice hours, as laid down by the programme approving body, the UKCC (1988). It is common for each placement to be allocated a mix of students, some from each year of the training programme, to gain experience concurrently. When this occurred in this study it was possible to collect data from students at different stages of their training during a common time scale.

The sample population was also determined by the conditions laid down by the Royal Free ethics committee who agreed to this study taking place. The clearance to undertake this study specified that access would be permitted only to certain hospital placements namely two general medical wards and one general surgical ward, each of 28 beds (Appendix 1), and certain Community placements namely three Health Centres, one each in Belsize Park, Gospel Oak and Hampstead. This meant that only those students who were allocated to any of these placements during the two semesters when the study was being undertaken became eligible to participate in this study.

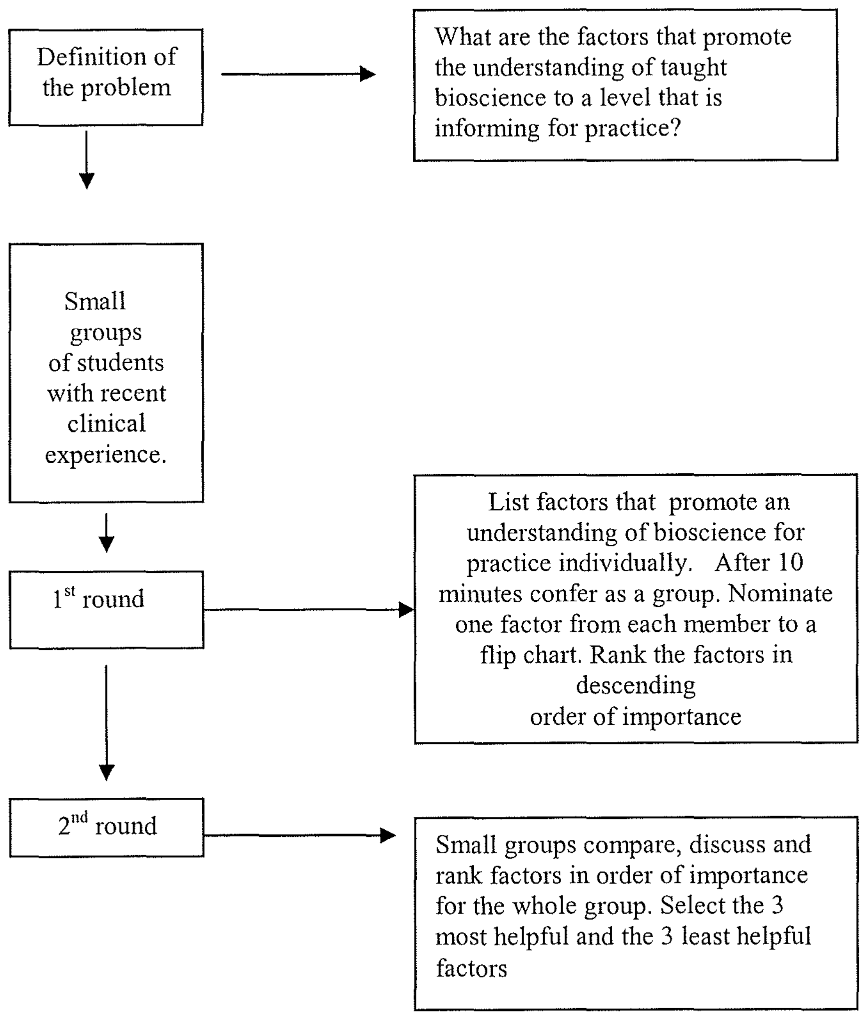
3.6 Qualitative Methods

The methods used for the data collection will be now be discussed individually, using a systematic approach and in the order in which they are listed above.

3.6.1 Nominal Group Technique (NGT)

The Nominal Group Technique (NGT) is sometimes referred to as a consensus method (Jones and Hunter 1995). The aim of such a method is to determine the extent to which participants agree about an issue. The participants are chosen because they are seen as experts in their field of experience. The researcher guides the discussion by setting a question on the topic for which information is sought. To carry out this method of eliciting information, participants are invited to identify relevant items concerning the given topic, discuss them individually in a small group and then rate them in descending order of importance. Finally the whole group considers all of the items identified by the small groups. The entire group then re-rates the items in descending order of importance.

Figure 4: Flowchart showing the pathway of Nominal Group Technique (NGT)



Adapted from Jones and Hunter (1995)

3.6.2 Student population for the NGT

Sixty-two students participated in this data collection process. All the students were on the Diploma of Nursing course and were either at the end of their first year,36% (n=22), second year 32% (n=20) or third year of training 32% (n=20). The students were grouped together according to their year of training and interviewed as one group representing that particular student year. All the students had recently completed either a hospital placement in one of the designated hospitals or a community placement. The data were obtained during a study day for each group at the completion of the placement period. The students were of mixed gender with 75% (n=46) of the group being female. The average age of the students was 23 years. Eighty per cent of the student group (n=50) were of English origin, 10% (n=6) were Irish and the remainder (n=44) were of Asian and African origin.

3.6.3 Advantages and disadvantages of the NGT

A major strength of NGT is that it obtains a viewpoint of many individuals in a short time (Polit and Beck 2004). This was considered important as the opportunity to collect data from each student group was only available on one occasion before the students moved on to other placements and entered a different phase of training. This research sought to determine the processes students used in order to make their bioscience informing for practice. As it was considered that not asking students from each stage of their training could allow vital information to be missed thus the opportunity to gain feedback at the completion of the final placements for each year was a necessity.

Other consensus methods such as the Delphi technique and consensus development panels could have been used but these involve the use of pre-meeting questionnaires, sometimes for as many as two or three rounds prior to the main meeting (Bowling 2000). Questionnaires have been noted for their poor response rate at times (Cormack 2000, Bowling 2000) and in addition there was the need to fulfil the ethical agreement for this study of fully informing the students of the research and allowing them the opportunity not to participate or withdraw. Staff of the student placement office were the only persons who were fully aware of the students who would be attending each study day. If the researcher had used one of the other consensus methods of data collection the amount of organisation that would have been needed to track down the students individually, discuss the ethics and arrange for completion of the pre meeting questionnaires prior to the main NGT session would have presented considerable difficulties. Polit and Beck (2004) claim that consensus methods are good at obtaining information from large groups and this led support to the choice of the NGT as a method of data collection.

The NGT is not without its flaws. For example it has been accused of forcing consensus within the group and not allowing participants to explore the issues raised (Jones and Hunter 1995). Both Fink *et al* (1984) and Jones and Hunter (1995) suggest that this is due to selection bias since most NGT groups consist of volunteers and those who do volunteer tend to have strong opinions. As a result the view of the majority can be imposed on the minority. This was not felt to be important in this instance since the students were not going to be given the option of self-selection. Giving all the students the ethical right of choice to participate was more likely to rule out the emergence of biased data. In recognition of all the difficulties with consensus data, Jones and Hunter (1995) went on to add that although consensus methods were often used within health and education to identity health priorities for groups of persons, such as those suffering from HIV, or to assist with the design of educational programmes, the results of any consensus method should always be interpreted with caution and they are best used in conjunction with other methods of data collection. In keeping with this the use of the NGT constituted one of three ways used to collect data in this study, the mixture of methods serving to strengthen its findings.

3.6.4 Validity and reliability of findings

Validity is concerned with measuring what is to be measured and reliability is about measuring it consistently (Bowling 2000). Within the context of the NGT validity can be best achieved by using a framework of specific requests for all the groups. Streiner and Norman (1990) and Lo-Biono-Wood *et al* (1997) and Haber (1994) support the use of a framework but also recommend using several large groups repeatedly in order that one group's findings are more likely to confirm those from the other groups. Consensus methods tend to use small groups of 10 –12 persons, this study sought to overcome the narrowness of small group responses by using samples of students of at least 20 to achieve a more valid picture.

To achieve reliability and validity for these groups of students, each student and then each group was asked to consider the request stated on the framework and then to write down their own opinions in the order of importance that they considered to be correct. By collecting three sets of such findings from large groups over a period of one academic year, it was believed that there would be a greater chance of arriving at congruence of opinion and that saturation would be reached such that no new information would be forthcoming during the session with the last group.

3.6.5 Procedure

The students in this study were asked to consider the factors in their education programme that best assisted them to understand the bioscience that they met in clinical practice and the factors that assisted their learning the least. After ten minutes of individual jotting down of their ideas, each individual was asked in turn to nominate one idea to the group. The nominations were recorded by another member of the group on a flipchart. Similar suggestions were grouped together as an idea. When all their different ideas had been listed and grouped the students were asked to rate these ideas on a scale of 1-5, with a score of 1 being the most important and a score of 5 being the least important. When each group completed this task, all the groups presented their findings to each other. The overall groupings were discussed by the whole group and a re-rating of all the ideas presented was carried out using the 1-5 scale. Finally the whole group was asked to nominate from all the ranked factors the three items that promoted learning the most and the three factors that were the least helpful in bringing about learning of bioscience.

3.6.6 Analysis of data

The data of the NGT were analysed using the content analysis technique. Cohen and Manion (1989) defined this as counting words or themes and their frequencies. Word usage rates can be used to infer the importance or influence of a particular factor in a social setting. Any change in the frequency of a word rate could indicate that the social setting in which a factor is creating influence has altered so that the factor is now either more important or less important. This type of analysis can form the basis of comparison when looking for similarities and differences between groups observed in context.

In this study the students themselves created categories within their data by their choices of the three most influential and the three least influential factors affecting their learning. All the sets of data obtained from each of the student groups were examined and commonalties sought. These commonalties were re-ranked to provide one combined list of ratings. The percentage value for each rating was estimated.

3.6.7 Semi-structured interviews

The second method of data collection involved the use of semi-structured interviews. The research interview is defined as a two person conversation initiated by the interviewer that permits the recording of the responses made (Cohen and Manion 1989). However since it is also a direct interaction between two persons this allows subjects to be discussed in greater depth than would be the case if, for example, questionnaires were used (Bowling 2000). Interviews attempt to go below the surface of the topic being discussed in order to uncover new ideas or areas not anticipated at the beginning of the research (Britten 1995).

Interviews tend to be classified into three types, structured, semi-structured and in depth (Britten 1995). The semi-structured form of interview is focused towards a particular topic by the interviewer using open-ended questions for the sole purpose of gaining explanation and description about the focus subject. This list of open-ended questions is sometimes referred to as a topic guide (Cohen and Manion 1989) and is usually derived following a pilot study in which the main topic is discussed and key areas are identified from the transcriptions of the pilot interviews. Barker in Cormack (2000 p 232) states that topic guides are a form of *gentle persuasion* that allow opportunities for the expansion of replies.

The semi-structured type was chosen for this research as it assisted in keeping the focus of the research to the forefront of the respondent's thoughts. This was important for this study as there was a need to interpret and understand the meaning of the particular ways that students used to bring about an understanding of bioscience theory for practice.

3.6.8 Student population for the interviews

Eleven students from the original population provided the data for the interviews. These students had not been part of the NGT data collecting process. All the sample students were on the Diploma of Nursing course and at the end of either their first year 18% (n=2), at the end of their second year 27% (n=3) or at the end of their third year 55% (n=6) of training years. They were within two weeks of completing their placement on one of the designated clinical areas. The sample was of mixed gender, 82% (n=9) of them were female. Ninety per cent of the students (n=10) were of English origin with the remaining 10% (n=1) of Asian extraction. The average age of this group of students was 24 years.

3.6.9 Advantages and disadvantages of interviews

A major advantage of an interview is that it gives the respondent freedom to verbalise their thoughts without any impositions, allowing their experience to be more deeply understood (Stevens *et al* 1993, Bowling 2000). This means that ambiguities can be clarified and more information of greater depth can be extracted. The response is usually higher than is the case with questionnaires and respondents do not need any literacy skills. Rich and quotable data can be obtained. The importance of this was that discussion of how students made bioscience work for them in practice could be deeply questioned and explained. As this was an area which the literature indicated had never been researched before, it was important to gain detailed and accurate information. As a topic guide alone can only achieve so much, there is a need for the researcher to have good communication skills and to be able to guide the informant to discuss the core areas thoroughly (Britten 1995). Weak communication skills and lack of fluency in a specialist language could be a disadvantage in the use of interview techniques but in this study this was overcome by the interviewer being known to the students and being able to establish a good rapport with them from the beginning. The students knew the interviewer from their student days and claimed to feel at ease, to be able to talk freely and to use specialist terminology in the knowledge that it would not impose a barrier. Since formal permission had been obtained for the study and the students had been informed of this by both the researcher and the clinical staff, they felt that this interest by others in their clinical learning deserved to be validated by their response and participation.

However, this did make difficulties for the interviewer, as some students would seek to please and provide data that they thought the interviewer would prefer to hear rather than describing what was true for them. It was also important for the interviewer not to find herself being questioned by the students as this could allow them to impose their own concepts on the interview. A solution to this was for the interviewer to agree to give their personal opinion to the students at the end of the interview when all the questions had been answered.

3.6.10 Validity and reliability of findings

A topic guide can aid validity and reliability as it helps to keep the topic to be explored in focus throughout the interviews hence yielding useful data rather than merely interesting but irrelevant findings. Difficulties with validity in interviews are usually the consequence of the interviewer or respondent, or both of them, having preconceived ideas about the possible findings of the interview. Another aspect that was of concern for this study was that of confidentiality. Some students were concerned that negative comments about the educational establishment, the clinical areas and the students' teaching and learning difficulties would incur consequences for their progress through the course. Such concerns could result in bias in the data (Cohen and Manion

1989, Britten 1995). One way of reducing bias is to ask the respondents to assess the accuracy of the data interpreted by the researcher by reading the final summary of the data. Another other way of dealing with the concerns of anonymity was to accede to the students' request not to tape record their comments and use only unsigned paper copies of interview summaries.

Support for the students' request comes from Bell (2005) who puts much emphasis on confidentiality on the part of the researcher and states that no symbolism should be put on a response that could lead to the identification of the respondent otherwise your promise to maintain anonymity is false.

In order to achieve as great a degree of reliability and validity as possible in this study, a topic guide was devised and used with all the interviewees. Secondly all interviewees were asked to read the interviewers' write-up of the interview session and to confirm or otherwise the interpretation, so providing respondent validation. No signatures were obtained to confirm the interview content and no tape recordings were obtained.

3.6.11 Derivation of the semi-structured interview guide

Prior to the main study using the interview technique a series of six unstructured interviews was conducted with Diploma of Nursing students whilst they were in the clinical placement. The students were invited to talk about how they came to use and understand the bioscience that they previously learned in the educational setting. There were no set topic questions, just the one opening statement. The researcher confined the discussion to elucidating doubtful points and rephrasing the students' answers. These interviews were captured on a tape recorder for a twenty minute period. Following this, each interview was transcribed and analysed. Four main points were in common were identified from all the transcribed data and subsequently used as the topic guide for the main data collection, which took place at a later time.

Patton (1980) listed six types of questions that can be used to obtain different types of data. In general, good questions are necessary but not sufficient for obtaining good data (Erlandson *et al* 1993). Three types of questions from Patton's list were considered to be the most relevant to this study. They were:

- Questions to elicit descriptions of experiences
- Questions about knowledge and factual information
- Questions about emotions

These three areas formed the basis of the main questions which were developed from the focus points found in the unstructured interview data.

The open-ended pilot interviews were undertaken over a period of six months and were completed prior to the main data collections. Students who participated in this series of unstructured interviews were not included in the main data collection that followed.

3.6.12 Procedure

All the semi-structured interviews were conducted by the same interviewer for the same length of time, i.e. 30 minutes. The interview was structured around the following derived points in order to give focus to the informant's comments on how they had come to comprehend bioscience theory for clinical application.

- The importance of bioscience for practice
- A description of an experience for which a knowledge of bioscience was needed
- How the theory was used to make sense of the practice
- How useful was the bioscience that had been taught in helping the informing of practice
- Anything else that improved the understanding of bioscience

The information was recorded by the researcher in a written form on an interview schedule sheet that was designed to allow room for the writing of notes (Appendix 3). The sheet was completed immediately after the interview and on all occasions the informant was asked to confirm or otherwise the correctness of the information detailed thereon. The point at which the end of the interview was deemed to have been reached, was when no new information was in evidence. This point is often referred to as saturation point.

3.6.13 Analysis of data

Following confirmation of data correctness, the researcher initially listed the responses to all the interview points from each respondent. The responses were compared with each other and then listed again. This time common responses were arranged together to form themes. Reading and re-reading an entire batch of data in an attempt to identify a category system of common themes and ideas is referred to as using a template analysis approach (Crabtree and Miller 1992). Four themes emerged following this process. In order to ensure that the themes did indeed represent what the students had said, an additional step to validating the data was undertaken. This involved a second person who had not been party to the data collection reviewing the data obtained and the themes derived in order see if both fitted. Although this step does not ensure validity of the themes it can minimise any idiosyncratic biases (Polit and Beck 2004).

3.6.14 Critical incidents

The third method of data collection used the critical incident technique. This technique focuses on a factual event that has had a discernible effect on the person involved, usually allowing or preventing the accomplishment of a specific activity (Polit and Beck 2004). Flanagan (1954), from whom the idea originated, described such observations of human behaviour as complete enough in themselves to allow inferences to be made about what was seen.

He claimed that this technique not only allowed for the identification of particular elements within a context, it also exposed the stressors and conditions that impaired performance within that context. Critical incidents are described by Cormack (2000) as not just a collection of direct observations of human behaviour but as a technique that has the potential for solving practical problems.

Critical incidents have been used in health care research to identify feelings, behaviours and attitudes or in the investigation of particular clinical cases where the focus was on why and how an intervention succeeds or fails (Clamp 1980, Keen and Packwood 1995). Earlier studies by Flanagan, Gosnell and Fivars (1963) showed how the critical incident technique could be used to determine the categories for assessing a student nurse's clinical performance. Rich data about critical incidents are best obtained if some form of structured data instrument is assembled (Flanagan 1954, Erlandson 1993). A framework assists the informant to consider carefully each aspect of an incident and to focus their description on the event being considered. To achieve such a focus the discussion in this study centred around the points which had been determined in the pilot study for the interviews. The form of these points was modified to suit the critical incident as a method of data collection, again considering Patton's guide (1990) as to the types of question. The framework was:

- Think of an incident involving yourself and a patient that you considered to be very memorable. The incident may be something that made you feel happy, sad, frustrated, angry, frightened, satisfied
- Describe your incident
- Which part of your incident involved an understanding of bioscience
- How did you make the connection between what you experienced and bioscience?

(Appendix 4)

3.6.15 Student population for critical incidents

Twenty-one students provided results for this method of data collection. The students were in either their first year 33% (n=7), in their second year33% (n=7) or their final year 33% (n=7) of the Diploma of Nursing (HEd.) programme. All the students were within two weeks of completing periods of clinical placement in an acute hospital setting or in the community. Seventy per cent (n=15) of this group were female and the average age was 22 years. All of the students were of UK origin.

3.6.16 Advantages and disadvantages of critical incidents

The major advantage of the critical incident technique is that it provides a sharply focused description of the event in question. Generalisations are discarded and personal opinions and judgements are minimised as the descriptions of critical incidents concern actual events and not what is believed should happen (Clamp 1980). Critics of this method consider this technique to be too individualistic to be of value outside the original setting. Other researchers fear that it creates undue tension in the participants because the personal stress in recalling the experience affects their memory of the event (Cohen and Manion 1989, Smith and Russell 1991). However, this technique has been used extensively in health care settings and in health care education to provide the basis of an assessment framework (Benner 1984), role analysis for staff (Smith and Russell 1991) and procedures for determining the choice of intravenous needles (Olson and Gnomes 1996). The ways that nursing students developed to learn bioscience for practice were important to this study since there is a lack of understanding of how all students of health professions learn. The critical incident technique is specific in describing what people experience and this factor made it a good choice as a method of data collection.

3.6.17 Validity and reliability of findings

As suggested by Flanagan (1954) to achieve validity for these data a framework should be used. The framework used the four focus points that had been determined in the pilot study for the interviews but modified then to suit the critical incident as a method of data collection using Patton's rule (1980). Reliability was sought by collecting data for a period of approximately one calendar year from a total of 21 students. At the end of this time there was evidence of repetition of findings coming from all the students. Beyond this point of saturation no new findings are achieved and the data source is redundant (Polit and Beck 2004).

3.6.18 Procedure

All of the discussions with the students took place in the practice setting where the incident had taken place, but in small groups of up to three students at one time. Using the framework, the students were asked to identify a patient from their practice setting who had had a presentation indicative of disturbed homeostasis and who was especially memorable to them. Each student provided a verbal description of an event in this patient's course that they identified as having been critical to them individually. They then wrote their own account of this patient and explained their account in detail to the researcher and other students as appropriate. This included exploration of why the students thought a particular bioscience event happened and how it influenced their learning. An original copy of that account was given to the researcher. The student replies were written rather than tape-recorded as the students claimed to feel less inhibition and less embarrassment in describing their incident if they could write about it rather than be recorded.

3.6.19 Analysis of data

The data were analysed using the template analysis style (Crabtree and Miller 1992). The interviews were repeatedly read and specific themes identified. These themes formed the units of a framework on which all the subsequent data were coded. The students identified very different situations that they called *critical* to them personally. The ways that the students selected as having helped them to understand the bioscience of each situation were listed. The lists of findings from each student were compared and common ways that students used for learning were grouped together. The number of common ways of learning was counted and a percentage rating was estimated for each one. At the end of this process four categories of information emerged. The final themes were scrutinised by an independent researcher who compared the raw data with the final themes before confirming their fit with the data.

3.7 Data triangulation

Another strategy to enhance the reliability and validity of the data in qualitative research is triangulation (Polgar and Thomas 1998). Essentially triangulation is a strategy that will aid in the elimination of bias in order that a deeper and undisputed understanding of the phenomena being studied is acquired.

Triangulation is described by Campbell and Fiske (1959) as the using of multiple methods to research a question. In his detailed discussion Denzin (1978) outlined four types of triangulation. They were:

- Data collection using different data sources
- Investigator triangulation
- Theory triangulation
- Method triangulation

Where all the methods used within a data collection type support a finding or at least do not contradict it, the validity of the data is seen to have been established. In this study two types of triangulation were used. They were data collection using different sources and method triangulation.

3.7.1 Data triangulation using different sources

This type of triangulation refers to the use of different persons to provide the information needed. It is necessary to do this as the view of an individual is always subjective. In research the desired state is one of objectivity for it is in being objective that the bias is removed and the truth of the situation exposed (Polit and Beck 2004).

In the case of the NGT three different groups of students from within the practice setting were used. All were at the end of a placement, at a different year of training and questioned by the same researcher using the same questioning strategy. This approach was also copied in the interviews involving the students. While in the placement settings of community or hospital, different students in different years of their training provided data using the semi-structured interview guide and the same researcher.

The critical incidents involved asking samples of students at different years in their training programme how they came to understand bioscience changes seen in a critical incident. The students provided this information while they were in the clinical setting, the context in which the incident had occurred. By collecting data from different students at different times in their programme within the context of their learning it was reckoned that the only factor that should be different for the students was the process they used to enable them to understand their bioscience for practice.

Denzin (1978, p. 274) names this technique of varying only the persons in a research method as a *within methods triangulation* approach. This approach to the elimination of bias is in itself limited. The between-methods technique is much more powerful. However it could be argued that using both types of triangulation throughout the entire data collecting process assists in keeping the researcher sensitive to the effect of possible bias and always seeking to use ways that eliminate bias as far as this is possible.

3.7.2 Method triangulation

The other form of triangulation used in this study involved multiple methods in the examination of phenomena. This is the most discussed type of triangulation and specifically three different methods of data collection were used on different sets of students at different times in an attempt to cross check interpretations of the events. Denzin (1978) describes this as a *between-methods* triangulation strategy and suggests that it is a much stronger and more satisfying approach to the elimination of bias. The rationale for such a strategy is that the flaws of one method are often the strengths of another. Combining methods of data collection allows researchers to achieve the best of each method while overcoming their unique deficiencies. This was seen as very desirable for this study as it offered a more valid set of research findings especially, when combined with that of data triangulation.

While the use of triangulation in qualitative research allows for a more complex and varied picture of the situation to be studied, the principal intention is to arrive at a convergence of data findings. It was anticipated that if reliability has been achieved the same ideas would emerge from the findings whichever method of data collection was used. By considering the limitations of each of the methods used and incorporating ways to improve validity and reliability it was intended that inaccuracies in reporting and other biases would not distort what the data would expose regarding the learning of the bioscience in the clinical context.

3.8 Limitations of the study

The qualitative strategy adopted proved appropriate to meet the objectives of the present study. In order to improve reliability and validity for the study, triangulation was carried out. Despite this, several issues arose during the study that may have had a bearing on the outcomes.

The first of these related to the student population considered for the study. The use of one population of students from one educational establishment on one Diploma of Nursing programme made this study group small relative to the total number of suitable students available within all the UK training establishments. London alone, the setting for this study, has 31 educational establishments offering undergraduate nursing programmes, each with an annual intake of 600 students (UCAS 2003).

Different educational establishments vary their selection procedures for students. The minimum entry requirements for the Diploma in Higher Education course at any UK University was 4 GCSE passes and one A level GCSE pass, but mature students could be deemed acceptable without these prior qualifications if they offered alternative certification (Higgins 2001). The average age of the Nursing Diploma student at the researcher's establishment during the period of this research was 27 years, and, as mature students, many had been offered places based on their personal educational attainments rather than the usual GCE attainment. Middlesex University is based within the London area and, like other London higher education establishments, is attractive to overseas students who wish to have easy access to the travel facilities for going to and from their homelands available to those who live in a capital city. A number of students in the sample population came from overseas and were accepted to the course with overseas entry credits. The effect of variations in the level of academic achievement at the point of entry to the programme could have resulted in the data having been biased by a batch of students who had a greater disposition to using a problem-solving approach for their learning. This may have made it appear that the most effective approach for the learning of bioscience is problem-based one when this may not be the case.

Secondly, it is possible that the sample group used was biased by the way in which the respondents were selected. The clinical placement areas available for the research were dictated by the managers of the practice setting and the head of clinical nursing services in the hospital. This meant that for the three year programme, only 94 out of a total number of approximately 1,000 students were available to provide information for this study since they had been allocated to the designated placements during the period of the research. A larger sample of students might have provided more support to the findings about the learning of bioscience.

Thirdly, the choice of methods used to collect the data may have influenced the findings of this study. The use of critical incidents and interviews allowed the students to detail freely their own beliefs. It was evident that students who provided data by either of these two methods provided a greater description of their experiences than the students who provided data via the nominal group technique. As a research method NGT tends to force a consensus of opinion and this may have obscured the true experiences of the learning of bioscience for some individuals within the group. Although it was recognised at the outset of the study that consensus methods of data collection have a tendency to do just this, it was not fully appreciated until all the data were viewed together. The fullness of the data obtained by the other two methods revealed that the consensus method was indeed a less effective probe into the reality of the students' learning processes. A recommendation would be the use some other more searching qualitative method such as reflective diaries or case histories to obtain relevant data.

A fourth source of bias included the attitudes and opinions of the researcher (Polit and Beck 2004). There is a tendency for research interviewers to look for answers that support their intellectual investment. Researchers may attempt to explain questions to respondents in the name of clarity and, in so doing, they invite compliance on the part of the respondent or cause the respondent to withhold information for fear of offending the researcher. This is especially likely if the researcher and the respondent are known to one another, as was the case in this study, where the researcher had also been subject tutor to the majority of the students who participated in this research at some time in their training period. In such a familiar context the respondents tend to ask the researcher questions during the interview. The researcher's answers may have unconsciously communicated her expectations and provided the respondent with cues as to how they could best reply. Researchers in such studies need to be constantly aware of the need to listen rather than participate in the discussion, while at the same time encouraging disclosure and elaboration.

The fifth limitation related to the position of the researcher as tutor and to confidentiality of the students' data. The students in this study became assured fully of the researcher's intention to maintain their confidentiality when their refusal to have their answers tape-recorded or video taped was adhered to. Although data held on tape are more reliable than paper records students felt that voice recordings and picture images could be used as evidence against them whereas the source of their own writing would always be much more difficult to prove. By not using any form of tape-recording during the interview it was hoped that bias would be lessened, as respondents would feel free to state their true beliefs.

The final limitation related to the use of triangulation. Although it was intended that the use of the different forms of triangulation and different methods of data collection would be more likely to result in a convergence of data findings it was also possible that this would not happen and the data would be inconsistent or at worst contradictory. This is most likely when multiple methods are used to collect data. The intention of this study was to search deeply and widely into the how the students learned bioscience that was useful for practice and because of the large amount of data that would emerge it was more likely to produce many perspectives that could be ambiguous and leave the researcher with nothing useful with which to construct explanations.

3.9 Ethical issues

Middlesex University supported this study. The Ethics Committee of the Royal Free Hospital approved access to nominated clinical placements within the hospital setting where the students would be allocated (Appendix 1). The clinical placement was contacted and the nature of the study explained, and participation in the study by allowing the researcher access to the students was requested. It was considered important that the clinical placement freely agreed to the study in order to provide compliance with the ethical principles of autonomy and informed choice. All the placement sites agreed to allow their students to be approached concerning this study.

The students on each placement were approached as a group by the researcher and told of the aim and the nature of the study. They were offered the opportunity to contribute to the study and assured there would be no penalty for them (Appendix 2). All the students approached regarding this study agreed to participate.

No names or identifying information relating to patients or the placement in question were included on any of the data papers. Students were described according to their year of training and under the pseudonym of a personal number to conceal their identity. This is in keeping with the ethical principle of maintaining anonymity and confidentiality.

Summary

Three qualitative methods, nominal group technique, semi-structured interviews and critical incidents were used to collect data for the assessment-fact finding part of this action research study. Each method has been described and a rationale provided for its choice. An explanation of the study programme and the sample group have been provided. The limitations of the study overall were discussed.

The educational establishment was supportive of this study. The ethics committee of the hospital agreed to the study but specified the placements to be used for the collection of data. Confidentiality and anonymity were assured for all involved.

CHAPTER 4

RESULTS FROM THE QUALITATIVE METHODS

4.0 Introduction

The findings presented in this chapter are the consequence of using three different methods of data collection with different sets of students at different times in an attempt to understand how the clinical settings to which students were allocated assisted their learning of bioscience. The use of multiple methods permits a more complex and varied examination of the phenomena of interest, with the principal intention being to achieve convergence of the findings. In addition, this provides a way of cross checking the interpretations of events and assists in the elimination of bias.

4.1 Nominal group technique

Sixty-two students provided the data for this set of results. The entire group was made up of three sub-groups of students, each one representing a year of the training programme. The findings of the NGT were analysed using the content analysis technique. Each factor was given a rating by the students with 1 being most important and 5 least important. The number of students providing each rating was counted for each group and a percentage estimated. Finally the percentage ratings for each factor in all the tables were combined and estimated The results from each sub-group were as follows.

Table 1: End of 1st year student nurses

Student ranking	Factors that were rated the most important in promoting student learning	No. of students	%
1	Clinical practice with patients and other health care professionals	16	73
2	Ward teaching and supported clinical learning	17	77
2	Seminar group discussion with peers and other professionals	18	82
3	Stated clinical objectives which linked back to bioscience theory	16	73
3	Skills laboratory which focused on clinical skill acquisition	13	59
4	Emotions	7	36
	Factors that were considered the least important in promoting student learning		
1	Clinical placements where staff are mostly care assistants	21	95
2	Lectures	15	68
Total number of students participating 22			

Table 2: End of 2nd year student nurses

Student ranking	Factors that were rated the most important in promoting student learning	No of students	%
1	Clinical practice	19	95
1	Clinical teaching with patients and a mentor	19	95
2	Stated clinical objectives which linked back to classroom theory	18	90
2	Begin learning about bioscience from the simple to the complex	16	80
3	Taught bioscience theory related to practice in sessions using patients	15	75
4	Emotions	10	50
	Factors that were considered the least important in promoting student learning		
1	Lectures	18	90
2	Laboratory sessions	19	95
Total number of students participating 20			

Table 3: End of 3rd year student nurses

Student ranking	**Factors that were rated the most important in promoting student learning**	No. of students	%
1	Analysing and explaining what had been seen in clinical practice with other health care professionals within a team	19	95
2	Disordered bioscience studies to make practice meaningful	19	95
3	Good teachers with expert bioscience subject knowledge for practice	19	95
4	Emotions	11	55
	Factors that were considered the least important in promoting student learning		
1	Lectures	17	85
2	Laboratory sessions	15	75
Total number of students participating 20			

Tables 1, 2 and 3 indicated the factors had the greatest influence on student learning. Some of the factors influenced their learning positively while others had a negative effect. The order of importance as rated by percentage estimation is shown in Table 4.

Table 4: Common findings for all three student groups

	Factors that promoted student learning.	%
1	Clinical practice	89.
2	Clinical learning in a supported environment with expert teachers	84
3	Learning disordered bioscience using patients	75
4	Emotions	47
	Factors that impeded student learning.	
1	Laboratory sessions	85
2	Lectures	81
Total number of students 62		

Each of the factors will discussed in greater depth throughout the remainder of the Results chapter.

Promoters of student learning

4.1.1 Clinical practice

Clinical practice was ranked overall by the students as being the most important situation for promoting their learning of bioscience (see table 4). First year students saw this factor as being of less importance to their learning than the second and third year students. As the student experience in placements became more extensive the perceived value of the placement learning environment increased.

The students included within clinical practice any situation in which they had been involved with patients or clients who had needed care, attention or education to enable them to attain health.

Patients made me go back and read about aspects of bioscience, especially as patients have problems with a whole biological system, not cellular units as we are taught in the first year of the course. These units may be the building blocks of life but they are not what is seen and discussed in the practice setting except for malignancies of course - the noble exception *(3rd year student)*

Ward practice meant that I had to discuss and talk bioscience terminology in relation to my patient in front of and with the ward team. I found this helpful as it made me work out the meaning of what was being said and what I was saying (2nd year students).

Practice placements provided a great deal of opportunity to put into practise what we had learned. The best thing about these experiences was that it made you learn in your own time (1st year student).

The clinical practice setting could have been in the hospital or the community. The students felt that the two settings were equally useful. However the learning opportunities within the practice setting had to have been supported by other qualified professionals who had provided for the health care needs of patients in that particular setting.

Working with other professionals on the ward allowed me to participate in a way that I thought made me learn the most about bioscience. Theoretical learning never had this effect on me unless the lecturer reflected on their practice experience during the lecture. The thing was that most of them did not do this and theory was mostly to be endured (1st year student).

I found my community placement most relevant to my learning because the District Nurse and the Health Visitor related my learning to their patients by discussing the bioscience of those patients in relation to my learning objectives (2nd year student).

Staff on my placements used to teach me bioscience from the altered perspective so that I could understand what was happening to my patients. I found this the best way to learn this subject (3rd year student).

Students reported that there had been an element of uncertainty and unpredictability in the patients' presence. The patients' needs tended to change continually, leading the students to recognise the clinical environment as being dynamic. The students described this environment as being the *scene of the action*, where they had expected to find themselves when they chose their professional course and where they expected to learn. This expectation of learning in the clinical setting suggested that students were most likely to have been open to learning at these times.

Patients and relatives used to ask so many questions about aspects of bioscience, even simple things like what was I taking the blood pressure for, and why, was there a 'drip' (intravenous infusion) running. There were always different questions about such things. This prompted me to look things up and to try and link theory to practice (3rd year student)

I saw many different manifestations of disorders of bioscience in my patients in placement, some of them all because of the same problem. We students used to compare our experiences and discuss what it could mean (2nd year student).

Practice placements were helpful because you were in the same environment as the patients and we had to do many things that had only previously done in the skills lab. Now you had to interpret skills findings and they were always different for each patient and you needed more bits of information if you were to understand each time (1st year student).

Being with other professionals had permitted students' opportunities to ask questions and to discuss patient's situations. These aspects of the placement were especially emphasised by the students who included the term *facilitator* to describe the qualified staff who had helped them to understand the meaning of clinical events. Students had referred to such persons as being clinically skilled. Being with persons who had recognised the students' knowledge or need for it had made them motivated to learn and given them a sense of belonging to the health care team which had provided care for the patients. Many in the student group had acknowledged such persons as being great motivators for their learning.

Working with the trained staff on the ward and having the bioscience aspects of the patient experience explained to me put things into perspective and made me want to learn (1st year student).

Being expected by trained staff to know what was happening to my patient made me learn so that I could discuss things about patient conditions with the staff (2nd year student).

Being linked to a ward for weeks at a time meant you could work with a particular member of the team and see how patients progressed or deteriorated. You could learn about disordered biology and ask questions about aspects of abnormality. This made me feel more confident about looking after ill patients (3rd year student).

Discussion of what had been encountered in a practice situation had enabled the students to learn from their peers as well as other professionals. The chance to discuss and explore the shared practice experience had encouraged review of normal and abnormal bioscience and had prompted the use of appropriate textbooks and other resources. In essence all the students regarded the practice setting as the most enlightening, motivating and useful scenario for learning.

4.1.2 Clinical learning in a supported environment

Clinical learning sessions were considered by the students to be the second most important factor in promoting their learning. Students identified several methods of clinical learning that they believed to be important in assisting them to achieve a positive learning result. These are detailed as follows.

A. Using identified learning outcomes

Most learning in clinical practice was organised by the clinical practice staff around stated learning outcomes. Here the potential presented by the opportunity to become involved with patients was written down in the form of outcomes and the student was expected to seek to achieve these objectives within a realistic time span. Students found that this made them focus on areas of theory that related to what they were seeing and doing. Students described their learning as having been a progression that evolved from being a very simple understanding to a more complex aspect of the same situation. Being attached to a hospital ward or other practice setting meant that the student had been able to talk and discuss cases with the patients themselves in addition to other professionals.

What I found very useful was when we were told to go and look at a particular patient problem and link it to the clinical objectives for total patient care. You had to discuss this with the patient and look at the big picture, not just a small part of the whole ailment.

Everything about bioscience became more complicated as they (the patients) were so much more involved (2nd year student).

Final year students especially felt that the teaching and identified learning objectives in the clinical practice setting were very important in helping them link the taught theory of the course to their practice experience. When the facilitator was knowledgeable in the theory of bioscience and knew how to use this knowledge in practice useful learning was achieved. Without such a facilitator, opportunities for learning on a placement became no more than a waste of time. Students pointed out that although many teachers had Masters and PhD degrees in an appropriate subject area, they were not always able to explain the subject at a basic enough level of theory for this knowledge to have been of use to the students in practice. Teachers chose to explain a topic using complicated words and concepts. The teacher's ability to use theory in practice often seemed to be lacking.

There was an impression that the persons giving the explanation barely grasped the subject themselves and when asked to explain further, often fudged the question or fell apart altogether (3rd year student)

I felt that the sessions we had in the first year were largely inappropriate and badly explained. For example biochemistry is too large and complicated a subject for novices. I learnt nothing new and challenging (2nd year student)

B. Patient presentations

These were opportunities to contribute to discussions with other health professionals on a patient's present condition, history, treatment and investigations. Some of these sessions featured reflection on the actions taken by other professionals regarding treatment and care. For the students in this study these sessions prompted the consideration of past learning of normal bioscience versus the pathological bioscience of the present. They were forced to seek answers to bioscientific aspects of the patients' presentations and treatment that they did not understand. More senior students were especially supportive of this method of learning since it meant they could discuss aspects of disordered bioscience with the patient through the medium of symptoms. This deeper personal involvement tended to intensify the desire within the student to understand, whereas a lack of understanding created feelings of anxiety and frustration.

The issue of bioscience becomes more real when you go on placement. I feel that my knowledge is very limited. There is so much to learn. I think we should have more *placement learning from the beginning of our course. I only began to understand this subject when I went on my first ward placement and saw patients (1st year student).*

C. Skills workshops

Workshops allowed the in-depth exploration both theoretical and practical aspects of a topic such as wound care, ECG recording and interpretation, resuscitation, venepuncture and the giving of injections from. Some students described how consideration of the causes of wounds, the healing process, treatment and other possible solutions to promote the healing of wounds, made them learn. This learning was magnified for students who had seen wounds in patients within the clinical setting.

When I was on placement I saw wounds and sores and it was explained why people got them. We had a talk on tissue viability and how to promote healing. This was very useful to me (1st year student)

4.1.3 Learning bioscience using patients

All the students in this study considered knowledge of bioscience as important to their understanding of the patients' needs for care and ultimately to their decision- making responsibilities. Bioscience was rated as being a difficult subject by the students. It was considered by them to be best learned in small increments supplemented by examples and experiences from practice. Not only had the normal to be understood but also the abnormal in its many different guises.

The ward placement allowed me to start to get this subject into perspective. We used to hold seminars that specifically related to different clinical practice patients (2nd year student).

In order to achieve a usable amount of knowledge and comprehension this subject had to be revisited time and time again. There was a need to explore the many facets of bioscience presentation and construct a whole series of mental clinical images before the subject could even start to be informing for practice.

What I found helpful was when we could go and look at a particular patient, read up the disordered bioscience problem, talk to other professionals or just have our own seminar discussion all about the same patient (1st year student).

Course bioscience theory tended to be fragmented and not linked to the patient presentation. This reduced the student's ability to understand what was going on when they entered the practice placement. Seeing the abnormal first and then comparing it with normal function made the students motivated to find out more about this subject.

The only way I understood anything about this subject was on practice placement, when everything became real. I think we should learn this subject exclusively on clinical placement and beginning in the first year (3rd year student).

It seemed that the students found the practice placement promoted their learning of this subject by encouraging theoretical review using textbooks, research papers and peer group reviews, along with discussion with patients and other health professionals. A whole series of new approaches to learning began to be developed by the students themselves.

4.1.4 Emotions

Fifty five percent of this student group claimed to have had their learning influenced by emotions, which they identified as feelings of pleasure, uncertainty, anger and frustration with the learning of bioscience. These emotions, if experienced intensely, caused the students to adjust their personal learning techniques.

Semester 1 and 2 of the course did not contain the groundwork we required in order to understand bioscience in the clinical area. I felt deeply depressed by all this irrelevance. The only good thing it did for me was it inspired me to read more in my own time and use my initiative about my learning (3rd year student).

I felt very angry about this subject. The only useful method of understanding this subject is practice (see table 2 p126). The link between the college and the clinical area is just a big buzzword. We got no tutoring about how to understand bioscience in practice until we got into practice. Now I do all my bioscience learning whilst on placement (2nd year student).

We had a tutor who did tutorials and he invited group discussion on our clinical experience in relation to this subject. I felt pleased because at the end of these sessions that I understood more of the reality of this subject than some of my peers because of this approach (1st year student).

Students were most aware of effect of emotions on their learning whilst on placement. The clinical setting was sometimes described as exciting, terrifying, desperate and supportive. Feelings would vary from day to day and sometimes the students were aware their learning was accelerated and alternately slowed down by how they felt. The students in this study claimed that they were not aware of these emotional influences during lectures and other formal college teaching sessions.

Barriers to student learning

As well as certain situations assisting learning to take place, there were factors that impeded it. The students described two areas that they believed had placed the greatest obstacles to their understanding of bioscience, such that it did not inform their practice. These were lectures and skills sessions.

4.1.5 Course lectures in college

Lectures are a frequently used method of teaching. Students described lectures as *lists of facts and figures transcribed from a book and then recited.* The level of knowledge assumed by the lecturers had often been above the bioscientific knowledge of the majority of students. Most lectures did not feature the element of application. Since application acted as a motivator for learning its exclusion caused the subject content of lectures to be perceived as *useless.*

The majority of the lectures were dictatorial and very complex. Often they were did not connect to seminars. Topics seemed irrelevant and boring (1st year student).

Students stated that some teachers of bioscience subjects were not clinically qualified. Such professionals were not the best persons to be teaching on courses where the ability to apply subject material to a real life situation was the expected outcome of the course.

When I went on clinical placement most of the things we had done in the labs did not seem relevant and were hard to relate (1st year student).

I found the labs too crowded, too rushed and with not enough explanation. We were dealing with illnesses on the various placements. It would have been better if we had done patient pathology (2nd year student).

Any learning sessions that lacked the element of reality that students found necessary for their practice negatively influenced the acquisition of bioscience understanding and caused the students to feel angry and depressed about their learning of this subject.

Summary

The findings from these data suggested that an understanding of bioscience is perceived as being best achieved in the clinical practice setting in the presence of the patient. Theoretical knowledge, as judged by these participants, is valueless without knowing how the relevant principles should be recognised in reality. Bioscience has an abnormal component that also has to be learnt and understood. Such learning is maximised if it takes place in a practice setting that is educationally orientated and supported by knowledgeable, skilled, clinically experienced professionals. As course components can impede learning thus careful thought needs to be given to content, design and delivery of a course in bioscience if valued and valuable learning is to occur.

4.2 Semi-structured interviews

Eleven students provided the data for the semi-structured interviews. Six of the students were in the final year of their training, three students were in the second year and the remaining two students in the first year of their training programme.

The data were examined using a template analysis approach (Crabtree and Miller 1992), which involved reading and then re-reading the entire batch of data in an attempt to identify a category system of common themes and ideas. Four themes emerged following this process. They were:

- the contribution of bioscience to understanding the clinical experience
- bioscience theory within the training programme
- the importance of bioscience
- emotions

4.2.1 The contribution of bioscience to understanding of the clinical experience

In order to comprehend the bioscience of what was happening to a current patient students would compare the problems of one patient with those of another similar patient whom they had encountered previously.

I reasoned out this patient's treatment needs from the experience of having other patients who had difficulty with their urinary output (3rd year student)

In practice fluids are always given to hydrate those who are nil by mouth (NBM). Until you see it, you think NBM means absolutely nothing but fluids are given.
(3rd year student)

Student nurses found the demands of the ward environment had acted as a motivator for learning.

A knowledge of bioscience is needed to know that people with liver disease should not be given intravenous normal saline but Dextrose 5%. I did not know why but I did know from practice that this was what I should do. So I went away and researched into normal liver disease in order to find out and to understand why this was done.(3rd year student)

While working with patients newly diagnosed with diabetes mellitus this student had realised,

I need to be able to explain to the patient the changes that their body is going through since I will be involved in health promotion for diabetic patients. So I have got myself on to a course which will teach me and re-inforce the bioscience that I learnt as a student (3rd year student).

Here the understanding of the bioscience had been concerned with the teaching of patients. Many illnesses were disturbances of bioscience that were controllable not curable. Patients needed to know how to cope with this themselves since they were the ones who would have to live with the condition. Education enabled them to do this. It was mostly nurses who were asked questions concerning such conditions, and this in turn meant that nurses needed to understand the bioscience involved or they were unable to respond to this need in their patients. Many students claimed to have spent more time learning at the end of their training than earlier.

Since thinking about qualifying I have read more text books. I have even bought more text books. I refer to them more so especially when patients or other students ask me *questions that I cannot answer. It frightens me to think that I understand so little bioscience and that I will soon be accountable (3rd year student)*

Many wards had carried their own collection of learning material appropriate to their speciality. This material had also been used as a resource by the students who had been trying to find out the meaning of their clinical experiences.

Yes, I used the library, but I also used the teaching folder on the ward, which is compiled by the staff and is related to real patients seen on the ward (3rd year student).

and

There is a ward orientation programme here. I offered to do a session on it. That way I had to learn about what to do for diabetic patients. It worried me not knowing (2nd year student)

Learning whilst on placement had involved asking and listening or being shown something by other professionals related to the patient's care and condition. The *other* professionals most frequently named were the physiotherapist, dietician, pharmacist and the medical professionals who were actively involved with patients and their needs.

I asked other staff for advice and information. Also, I always go on the ward round where everybody discusses what is best to do for each patient (1st year student).

One student had been confronted with the problem of a large wound in a debilitated patient and admitted that he had not known how to treat it. He had had to seek the advice and the understanding of the wound care specialist. He claimed to have felt very *stupid* when he realised that he did not know what to do about this wound.

Another student's patient had become short of breath following the removal of an abdominal drain.

I worked out why he was having this trouble from an explanation given to me by the physiotherapist. She had seen this kind of thing before and she explained to me what was happening to this man (2nd year student)

Since patients and actively involved professionals could only be found together in the clinical placement it was not surprising that the students had seen the clinical placement as the most useful and lasting of all the situations that have promoted their learning. Here they continually found opportunities to apply bioscience and to learn this subject anew.

4.2.2 Bioscience theory within the training programme

Learning opportunities that allowed students to see and use bioscience in practice were considered to be very important in promoting learning.

We had a patient with a low urinary output. He had been nil orally for the last four days and his low output was probably because of his low intake. He could have been simply dehydrated. He had to have Haemacel (a blood volume expander) because his blood pressure was affected. A central venous pressure line was inserted so that we could monitor the hydration regime we were administering. They do not teach you bioscience like this in college. They always omit this sort of application, but this sort of understanding is so important (3rd year student).

It is normal practice to mentain hydration in patients who are nil by mouth with intravenous fluid regimes of sodium chloride 0.9% and dextrose 5%. The patient this student was referring to had the additional problem of having had considerable blood loss which necessitated the use of Haemacel and eventual blood transfusion after blood of the correct group had been located.

Another student added:

For example there are times when naso-gastric tubes need to be inserted into patients for the purpose of aspiration. This is especially so in intestinal obstruction when fluid will build up above the level of the obstruction and cause the patient to experience nausea and vomiting. My understanding of the gastro intestinal system as taught in college did not teach me this. I discovered this information on the ward from my patient, staff information folders and trained staff discussion (2nd year student).

The training course appeared to be more concerned with the ability to recall information and use this knowledge to pass exams. You learn a lot of stuff on the course just to pass the exams but retrieving that knowledge to use it again is very difficult. I really swotted for the bioscience exams but I don't find it useful to me now (2nd year student).

Many participants in the study saw this as a problem. Most of the bioscience topics were introduced in the early years of the course, a situation sometimes described as *front loading* of the curriculum, and this led to the students not realising the value of theory for practice. One interviewee said of the place of bioscience topics in the programme timetable,

... resulted in my not understanding the significance of what was being taught until I needed that knowledge in practice on the ward (1st year student).

Another said:

I found that the bioscience that I learnt as a student overwhelmed me (2nd year student).

The bioscience I learnt as a student was not useful in clinical practice. It was necessary to go and learn it again (1st year student).

The bioscience was comprehensive but often factual. I find it easier to learn if it is related to a patient (2nd year student).

The subject taught at college showed how well the kidney or the liver worked, but it did not teach me how the patient may present, or how care should be maintained for that patient (3rd year student)

Anger and frustration were expressed by the participants for what they had described as *wasted years learning bioscience* only to discover that they still knew *nothing* when they entered clinical practice. It was not considered enough to have learnt or been taught such subjects if their use in reality was not taught and learned as well.

There was not enough reference to cases - that is individual patients with specific conditions (3rd year student).

I find it difficult to access knowledge if application is not taught. Using case studies of specific patients would have shown the relationship between the signs and symptoms and the bioscience (2nd year student)

Some of the blame for this inability to apply the sciences to practice was directed at those persons who had planned and organised the course.

So much of the bioscience was taught at the beginning of the course and then was never really touched on again. This meant things could be forgotten (1st year student).

It was all concentrated in the first year and it did not relate to practical experience (2nd year student).

The principal reason students had not been able to use their bioscience knowledge appeared to have been the subject not having been taught in a manner that allowed the relationships between the topics covered and the problems patients experienced to be blatantly obvious. Despite the student dissatisfaction at not being able to link theory to practice and the perception that much time and opportunity for learning had been wasted, all the participants felt that the subject of bioscience was so important that it could not be omitted from the programme.

4.2.3 The importance of bioscience

The participants in this study emphatically and without hesitation asserted that an understanding of bioscience was important in helping them to make sense of clinical practice. Some respondents included additional words such as *definitely, crucial, so important* in order to emphasise how strongly they felt about bioscience being essential to understanding clinical practice. As one final year student said,

As nurses we are carry out many invasive techniques. Just giving injections is an invasive procedure. We all do it a hundred times a day. How can I safely invade people's bodies if I do not know where I'm going. I have to know about bodily systems and how they work (3rd year student).

Much bioscience taught in college is taught without the experience bit. Just think about all the diabetic patients I have to deal with every day. I need to understand about blood sugar and the effects of insulin working together not separately. Then you can tell if *something is going wrong or right for that matter. College only teaches the basic stuff, now I look up and find out all these things for myself, mostly by reading, but the experience counts for quite a bit (2nd year student).*

Students considered the subject of bioscience so important that they resorted to finding new ways to learn about it. Reading is cited by the above student, but attendance at a study day, questioning other health professionals, listening to others, reflection and teaching were all new approaches to learning that students did not claim to find available to them in the college learning environment.

4.2.4 Emotions

The students reported to having been most affected by feelings of frustration. They had reached an awareness of the importance of bioscience and how it was best learned by them. Sessions of the course delivered in the classroom had not realistically helped them achieve such learning and they had been forced to seek out other ways of understanding this subject for themselves.

I have referred to many text-books in particular those that look at this subject from an applied perspective - clinical manuals (2nd year student).

I have learnt from experience and other clinical staff members. I have asked hundreds of questions and visited many patients. I never really learnt anything useful about this subject when I was a junior student (3rd year student).

Summary

The semi-structured interviews indicated that the participants regarded an understanding of bioscience as important, if not crucial, to the care of patients. Feelings of frustration were experienced by the students when they became aware that the picture of normal bioscience which had been taught to them in their foundation years was not what they saw whilst on clinical placement. What the students saw in practice was a disturbed picture exhibiting varying degrees of deviation from the normal. Bioscience would only be useful if it was taught and learned in a manner that allowed an understanding of patients' presentations. One of the best ways to achieve this was to use the clinical practice setting and *real* patients to demonstrate and exploit this link.

4.3 Critical Incidents

Twenty-one students provided the data for this section. The student group was made up of first, second and third year students in numbers. Each student identified their own unique incident. A description of each critical incident is attached in Appendix 5.

The data were analysed using the template analysis style (Crabtree and Miller 1992). After the first three interviews the data were repeatedly read and specific themes identified. At the end of this process to all the data obtained formed four categories of information.

Table 5: Common themes identified within the critical incident data.

Theme	Number of students	%
1. Emotions	21	(100)
2. Clinical practice with real patients	19	(90)
3. Reflection on patient events	16	(76)
4. Practice skills	12	(57)

Themes emerging from the critical incidents

4.3.1 Theme 1: Emotional concerns

Emotional concerns affected all the students. They experienced very intense feelings of fear, anger, sadness, satisfaction or frustration. All the students indicated that the emotionality of the experience had affected their learning. They recognised that these emotions concerned their lack of understanding of abnormal bioscience. Students felt unable to assist certain patients because they did not fully understand the abnormal bioscience they were witnessing or had had described to them by the patient. They felt compelled to know and understand the abnormal bioscience seen in the critical incident. The emotional impact of these patients on the students was so great that they were compelled to seek to understand what had occurred. Thus many of the critical incidents were not only unique but they produced powerful emotional reactions that influenced learning. Emotional arousal acted as a powerful motivator to learning bioscience.

4.3.2 Theme 2: Clinical practice

Ninety five percent by the students identified the ability of this factor to promote their learning.

A student who had been involved with a patient who was rejecting a liver transplant that had been implanted twelve months before said:

The connection between what I saw as the patient's confusion, encephalitis, altered blood pressure was made by talking through the signs and symptoms with other qualified doctors and nurses on the team. This went on for two weeks when finally he (the patient) died (Incident 4).

Another student said, after being involved in the post operative care of a patient following abdominal surgery to relieve intestinal obstruction,

This whole experience of patient fluid hydration on the ward needed an understanding of bioscience. A lot of things began to click into place because I asked lots of questions to try and make this understanding (Incident 2).

And after having witnessing the collapse of a patient due to blood loss from bleeding gastric ulcers, a student wrote,

I knew about shock and haemorrhage and such stuff but remembering things from a previous study is quite difficult if it has not been followed up. I asked the trained staff to explain to me what was going on and what was happening. I felt so guilty that I had not been able to remember (Incident 6)

An understanding of bioscience was important if appropriate actions were to be taken for patient care. Failure to understand and to react appropriately induced emotions in these students that had a major impact on their learning of this subject.

4.3.3 Theme 3: Practising the skills involved in the critical incident

Fifty four per cent of students had found that this factor had increased their learning. An end-of-second-year student described how she dealt with the cleaning of a tracheostomy tube.

They had told me it was to keep the airway open. He could not breathe without it. I felt very frightened because, if it fell out would I be able to keep his airway open? Anyway, they then showed me how to do it and when I did it, it was ok (Incident 7).

A third year student who had dressed many wounds said:

This particular lady had a abdominal wound due to necrotising fascitis now eradicated. I was really frightened in case I introduced infection again. It was only my previous experience of dressing wounds that helped me here (Incident 3).

The learning achieved by using skills in the practice setting had proved invaluable in the more dramatic events seen in hospital practice. A final year student recounted how, on her first day on a new placement, a lady in one of the single rooms of her ward had a cardiac arrest. Although she had never met this patient and did not know her full history she felt able to participate in the resuscitation attempt.

We had practised this so often as part of the workshops on cardio-pulmonary resuscitation that I understood about chest compression, rebreathing, oxygen and getting the heart going (Incident 9).

The students saw practising a particular skill in a clinical setting as another way of relating the bioscience theory to the practice, especially when it involved a real patient. Students had learnt many skills to support their training, but in a skills laboratory. Such skills lacked the reality of the patient setting, with the result that the sequence of actions needed to support the skill was mostly learned in isolation from the theoretical understanding. Simply through practising it, a skill could be reproduced by a particular cue. When such a skill was used in reality, the student saw the gap between the understanding of the relevant bioscience and the actions carried out within the skill. The particular student quoted above had felt saddened by the event that ended with the death of a patient she did not know, but it had intensified her desire to understand the bioscience involved in bringing about the fatal changes that had taken place in this woman's cardiovascular system.

4.3.4 Theme 4: Reflecting on past experience

Seventy two percent of students stated that this factor had been of help in enabling them to understand the relationship between bioscience and practice. Having seen an event before provided the student with a reference point that assisted them in understanding the current situation. The past events that the students referred to were previous critical incidents that had happened some time ago and sometimes on another practice placement.

I knew about this because of my experience observing injection giving. I thought there must be a slipped disc or something trapping a nerve. The pain from this lady's buttock radiated into her leg and into her foot. I thought it must be the sciatic nerve and not the injection. The trained staff confirmed the correctness of my reasoning. I felt pleased with myself that I had figured it out (Incident 8).

The gluteus maximus muscle in the buttock is a common site for intramuscular injection but care must be taken to use only the upper outer quarter in order to avoid the sciatic nerve completely. This student was aware that using any other part of this muscle as an injection site could cause sciatic nerve injury and she was able to compare the current situation and a past situation involving injection giving and reason that the result of this patient's pain was not related to injection giving but nerve pressure from another source.

Whilst on her placement in Accident and Emergency, a final year student had encountered a gentleman lying on a couch in a waiting room and complaining of pain. She had realised from the description of his pain that he was probably having a myocardial infarction but because she had seen in a previous case *chest pain* when the pain had originated from a nearby organ, the stomach, she was not absolutely certain that the pain in this man had been related to his heart alone.

She said:

I knew the only way I could distinguish between the two was by doing an Electrocardiograph (ECG). I have learnt this from past experience (Incident 5)

Electrocardiographs (ECGs) are regularly used in clinical practice to determine whether changes have occurred to the electrical cycle of the heart rhythm. Myocardial infarctions in which there is death of the heart muscle often produce such changes which are readily visible within 24 hearts and so assist with the diagnosis of such an event. It is possible for infarction to occur and leave no trace on ECG but this student was aware from her experience that the majority of infarcts left some evidence that would be of assistance to her and she was hoping to find it so that she could distinguish between the origins of the patient's pain

Past experience provided information to help in the identification of the current situation and this in turn influenced decisions about what to do next. Experience of previous, similar cases encouraged the learning of bioscience variations presenting in a disordered form. The student cited above showed signs of the development of critical judgement as she now begins to look for the minute differences in presentation that assist her in deciding what to do next. Knowing where the pain originated allowed choices to be made.

A student who witnessed a young female patient having a grand mal fit said, *When it was happening I was so shocked I didn't know anything. We had been taught about it but that is not the same. I read about it afterwards in many books. It was different then (Incident 10).*

and

This man walked into A and E with breathing difficulties. He was navy blue and making a lot of noise with every breath. I was panicked into getting this man into the Resus. Room. I felt very nervous in case he arrested. Everyone was rushing around. As soon as I got home and before I could go to sleep, I had had to read about it to find out why they thought he was going to arrest. Doing this helps me to understand a lot (Incident 11).

Being part of an experience changed these students' perceptions of their situations such that when they read about them afterwards they were able to understand the clinical events so much better than if they just read about them first and witnessed them later. Reflecting on an event can promote learning if the reflection involves other aids to learning such as books, texts and discussion with other professionals (Appendix 6).

4.4 Conclusion

Three different methods were used to collect data to identify the factors that Diploma of Nursing students considered to have been the most effective in promoting their learning of bioscience. They were the NGT, semi-structured interviews, and critical incidents. A total of ninety-four students contributed to the data obtained. The factors that promoted learning are tabled as follows.

Table 6: Summary of findings from all the data collection sources

Promoters of learning
Nominal group technique
o Clinical practice
o Organised clinical learning
o Application of theory sessions
o Emotions
Semi-structured interviews
o The contribution of bioscience to the understanding of the clinical experience
o Bioscience theory within the training programme
o The importance of bioscience
o Emotions
Critical incidents
o Clinical practice
o Practising clinical skills
o Reflecting on the past experience of a similar happening
o Emotions

Following examination of the findings from each set of data the following common themes become apparent:

Table 7: Common themes for all three sets of data

1. Clinical practice
2. Learning bioscience in a clinical environment
3. Emotions

The findings from the students in this study suggest that the learning of bioscience that is informing for practice is promoted the most by the above three factors.

Summary

Learning bioscience is facilitated in the clinical placement through critical incidents, but a much more emotional type of incident than described by Flanagan (1954) and Clamp (1990).

Critical incidents were situations encountered by students in the clinical placement that produced intense emotional responses that in turn acted as motivators to learning. The opportunity to explore an experience soon after it happened was regarded by the students as important for optimal learning that would be of use for future practice. Reflection with other qualified professionals heightened learning and increased the student's motivation to learn bioscience.

CHAPTER 5

DISCUSSION OF FINDINGS FROM QUALITATIVE METHODS

5.0 Introduction

This study originated from the belief that the educational programme studied by the student nurses on the Diploma of Nursing course did not prepare them to understand bioscience as it would present itself to them in the clinical placement. Student nurses on the current Diploma of Nursing programmes spend 50% of the course hours in clinical practice and 50% in the academic setting. The new programme allocated a greater number of hours to the study of theory than had been allowed on the old programme but still they claimed that the bioscience theory that they had learned in the academic setting did not assist them to understand the disordered bioscience that they encountered in the clinical setting. This claim was supported by research findings that had been accumulated since the beginning of 1990s and the commencement of the new Diploma of Nursing programme. The researchers for those studies would have carried them out on students on a similar programme to the present group of students but still they had obtained no new findings to indicate that the students' understanding of bioscience for practice was better on the new programme.

Many commentaries have been made in the literature concerning the bioscience component of such programmes, about the quantity of bioscience that nursing students should learn, about the value of this subject for practice, and by whom it should be taught (Wilson 1975, Hinshaw 1991, Trnobranski 1994, Twinn and Davies 1996, Davies *et al* 2000). Despite all the commentary, there appeared to be a paucity of research into how students best learned this subject in order that it informed their practice.

It seemed that one possibility was that the clinical setting was affecting students learning. The primary aim of this study was therefore to attempt to discover the process by which students came to understand the bioscience that they encountered in clinical practice and the factors that promoted development of this process.

The clinical setting included all the patients who presented with a disordered bioscience and who would expose students to the bioscience that they did not understand. If the clinical setting and the patient impacted positively on student learning then what systems had the student employed from within the setting to achieve learning. In order to determine whether the clinical setting was promoting the learning of bioscience all this study's data were collected from within this setting. The instruments discussed in the methods chapter that were used to collect the data were focused towards

- identifying the students' perception of a bioscience within that setting
- discovering which strategies the student used to reach an understanding of bioscience that was encountered therein.

The results of the data collection suggest that the learning of bioscience that informs practice is promoted the most by the following three factors:

1. Clinical practice that includes other health care professions. This creates a contextual setting that makes an understanding of bioscience relevant to the student.

2. Learning in a supported clinical environment where the learning material is based on real patients allowed learning to be structured for learning and linked. Learning material becomes the subject of discussion by the students, their peers and other professionals, and provides an opportunity on the part of the student for reflection.

3. Situations that provoke emotions such as anger, fear and anxiety influence the motivation of students to re-learn and understand bioscience to a level that allows them to interpret patients' presentations.

The remainder of this chapter sets out to explain the findings in relation to the literature where it is possible. The findings relating to the emotional influence on learning were entirely unexpected and additional literature has been added to explain their implications for student learning. The end reflective section identifies the next stage of the study and proposes a hypothesis.

5.1 Findings emerging from the data

5.1.1 Clinical practice

Clinical practice was described by the students as any situation in which they were involved with patients or clients. They defined the patient as a person who needed their care and attention to attain a state of wellbeing, or who needed the health education that would enable them to attain a state of wellness for themselves. All the students in this study mentioned patients they had encountered in the practice as being important in making them want to learn. They made reference to numerous placements and recalled many specific patients to illustrate how they came to understand a principle of bioscience.

This preference of students for the use of clinical practice in assisting learning is supported by the empirical studies of West *et al* (1982), Parker and Carlisle (1996), Hislop (1996), Fulbrook (2000) and Dammers *et al* (2001).

Parker and Carlisle (1996) using a convenience sample of student nurses (n=131), identified the practice components of the Diploma in Nursing course as being the most influential for student learning. They made reference to the failure of the new training programmes to link theory to the practice placements particularly in the early part of the programme. Their study into the value, relevance, teaching methods, intellectual potency and organisation of the programme concluded that the clinical area was where the most relevant learning occurred and in contrast theory was but an abstract ideal in the minds of the students. Seemingly student exposure to the clinical setting was not being made meaningful and Parker and Carlisle suggested that this may have been because the opportunities for reflection on incidents may have been neglected. A clearer focus on the theory practice divide was made by Hislop in his study from the same year using a random sample of 19 students. Here it was reported that the sequencing of clinical placement denied students opportunities to become sufficiently involved with the clinical team and so they wasted much of the valuable time that they could have spent learning in the clinical setting with the team. It made them feel *limited.* The students in Fulbrook *et al's* study (2000) felt that practice was being given second place to theory on the Project 2000 programme and when the students (n=43) eventually got to the clinical setting they were ill prepared and ill equipped for what was expected of them.

All the above studies were carried out on small groups of health professional students. The three groups involved were nursing students on the project 2000 training programme. It could be argued that all the groups are too small in number to provide findings that are of significance. While this may be true what should not be overlooked is the consistency of the findings from all of the groups all of whom were isolated groupings at different times on different university programmes. Their findings give support to one of the major themes to emerge from this study that the clinical practice is the most important place for learning for all students who aspire to be practising health professionals in the future.

Dammers *et al* (2001) also looked into the practice setting but this time she focused on the influence of the *real* patient on student learning rather than the team and team learning. The aim being to consider the effect of *real* patients on the learning of medical students undertaking the seven week community module of their course. She reported that the students claimed to have been so positively affected by the clinical context and the presence of *real* patients that they achieved valuable professional learning. Dammers' study, like that of Parker and Carlisle (1996), Hislop (1996) and Fulbrook *et al* (2000) was not focused on the bioscience component of the course but again provided evidence to suggest that clinical practice was influencing the students' learning in a positive manner. In 1982 West *et al*, when exploring the use of different teaching approaches in a community setting again with medical students, identified the patient as having a clear influence on students' learning. It seemed as though there were influences within the practice area that did not exist in the traditional educational setting. These influences had a strong positive effect on all students' learning, which would have included the subject of bioscience. Other research findings, such as those of Heron (1981), Schon (1987), Jarvis (1992) and Ashworth and Longmate (1993), support the value of patients within a practice placement for promoting learning. Although these, unlike the present study, were not focused on the bioscience component of the course, they clearly indicated the value of patients as an effective stimulus for a students' professional learning.

The present study, specifically into the subject of bioscience, highlights the patient in clinical practice as being a starting point of students' learning. Once students begin to spend time on a clinical placement, they become aware that the bioscience theories that they learned in the lecture hall and laboratory settings were not the same as the bioscience that they saw in the patients they encountered. The contradiction between what the student learned and the appearance of the patients in the placement setting acted as a catalyst for learning bioscience. The patients revealed to students the relevance of bioscience for practice, and this prompted students to begin the process of achieving an understanding of this subject within a *real* context.

Students referred to learning as having been triggered by a series of events that they described as having been *critical* for them. This suggestion by students that many discrete events could eventually come to make a whole has found support in the theories of Flanagan (1954) and Clamp (1992). In their theories concerning critical incidents they claim that each event provides a different insight into the issue being considered, and that in time all the insights together will reveal the whole issue. In this study students were able to recall many such events occurring on clinical placements and resulting in learning taking place. Such events were memorable because of the vividness of their presentation, but they had to be linked together before a full comprehension was reached. Maudsley and Strivens (2000) study into medical students comments on how they learned and developed incrementally by acquiring skills and experience in the practice setting and this finds support from the ideas of Heron (1981) on professional knowledge when she insisted that experiential knowledge was compulsory for professional course student if they were eventually to become knowledgeable and competent.

The data in this study showed that the patient affected the student's learning of bioscience by stimulating inquiry into the reason for his or her compromised health, and students monitored the clinical progress of their patients and the effects of the treatment they received. The patient became a point of reference and clarification for the learning of bioscience for the students. Learning within the confines of the patient context allowed knowledge and understanding to develop and to be supportive of practice.

Students began a process of reasoning about what was happening to their patients in terms of newly learned theory and not in terms of previously learned material that they perceived as incorrect or plainly lacking in clinical relevance. In order to achieve usable learning, it seems necessary for students to devise a different approach to the learning of bioscience. The students in this study claimed that they were not long into their course before they began to learn bioscience twice using two different but concurrent learning approaches. One approach was in the classroom and this allowed them to learn in a superficial way to pass their examinations (Newble and Clark 1986), while the other approach in the clinical setting allowed them to learn more deeply, to give consideration to the interelatedness of the human body and to the ways in which a malfunction interfered with a patient's normal daily activities. The latter has found support in the empirical studies of Jarvis (1992) and Ashworth and Longate (1993), who advocated applied learning for all the professional subjects rather than allowing two distinct sequences for learning that contribute to a theory-practice gap.

The findings of this present study indicate that within a clinical setting where there are *real* patients, the students perceive bioscience as complementary to practice and not separate from it. Support for this common belief amongst students was identified by the early studies of Nolan (1973) and Wilson (1975), and more recently by Schon (1987), Jarvis (1992) and Andrews and Jones (1996). The comments of the students in this study are supported by the Constructivists such as Dewey and Piaget, Brunner and Vygotsy. These theorists claim that meaningful learning occurs when people actively try to make sense of the situation in which they find themselves. They are critical of institutional learning which they claim amounts to a series of facts and theories that students learn to recall on cue and are of no use beyond the classroom. This was found to be true for the students in this study when they reached the clinical context.

5.1.2 Learning in a supported clinical environment

A supported learning environment was defined by the students in this study as any practice setting in which health care professionals attempted to assist their learning. The students emphasised that nursing is essentially a practical course and, in order to understand the subject of bioscience in a way that informs their practice, it is best learned while in the context of practice where the patient and other trained professionals can offer them insight and discussion into about what is seen. They questioned the appropriateness of a course for future professionals that was so theory-laden that the aspect of practice in relation to bioscience was minimised. In addition they made specific mention of approaches to learning that they had used in practice, which included discussion, the setting of objectives for learning appropriate to the particular clinical setting, practising skills and reflecting on and exploring case studies in conjunction with the patient and other professionals.

An approach that allows the student to explore the experience and begin the process of making connections between the experience and its meaning constitutes a deep approach to learning (Boud *et al* 1976). Like many other academic courses, the Diploma of Nursing programme demands much learning from books and emphasises knowledge from books as opposed to knowledge from practice (Schon 1987, Savin-Baden 2000). This is described as making use of the technical rationality model (Schon 1987). Schon argues that the use of this model of learning in professional educational establishments leads to the view that a professional's knowledge and understanding are more important than the ability to apply the information. As a consequence the specifics of practice that professionals consider essential to their learning are omitted leaving much learning unprocessed and simple (Eraut 1994).

According to the students in this study, teachers of nurses in the educational setting tend to use traditional methods of teaching and in so doing they experience little or no contact with individual students. Students said that the teacher's role was one of transmitting knowledge while the student's role was to receive it. Teacher-controlled learning makes use of the lecture method, the teacher-led seminar and laboratory skills sessions and expects students to absorb knowledge that is acquired along a linear pathway (Creedy *et al* 1992, Ghazi and Henshaw 1998). There were suggestions that the students felt discouraged from becoming actively involved in the process of learning because of large student classes, and that the teachers did not understand the subject as it would be seen in the reality of practice. Their comments are supported by the earlier studies of Newble and Clark (1986) and Slevin (1992). Newble and Clark investigated approaches to learning used by medical students in a conventional educational setting and they concluded that learning tended to favour a superficial approach where the emphasis was on being able to recall information to pass exams and get through the course, as opposed to developing an understanding of the material for practice. Although Newble and Clark's (1986) study was not focused on bioscience, it did support the present students' claim that the conventional educational setting does not promote learning that is valuable in professional practice. The comment of the students also raises the issue of scientific learning which was defined by Mathews (1994) as a different way of thinking about a subject. Zeegers (2001) made comparisons between science students and those studying psychology and arts. He noted that their learning was very different from that of the science students he was researching. He suggested that science students had to master much terminology in order to comprehend what was being said even before it was understood or applied and this tended to promote surface learning in order for the student to get through the course. One of the factors identified as influencing bioscience learning significantly is previous science experience. McKee (2002) relates how nursing does not make it compulsory for students to have at least biology 'O' so most of the students accepted to the diploma of nursing programme have little or no biological background. Despite all these obstacles the students managed to learn this subject in sufficient amounts for them to become competent practitioners once in the clinical context where the learning was approached in a different way.

Slevin (1992) identified students of nursing who came from conventional school settings as being unused to taking an active role in their education. As a result, they would endure traditional approaches to teaching even though learning achieved through these ways was not useful to them in practice. Younger students often saw University as a continuum of secondary school and persisted in using the learning methods they had always used (Zeegers 2001). Zeeger's study involving 200 university students, learnt support to Slevin's comments and identified in addition a resistance on the part of the student to try new methods of learning since they had proof from their experience that their methods worked.

Gibbs (1995) states that the problem is much wider and the consequence of having a national programme of training in which achievement is measured in terms of passing the examination rather than the ability to use knowledge in practice. Techniques of assessment that foster an approach to learning, in which success in an examination is seen as a reward, implicitly encourage the continuation of approaches to learning that are superficial. McManus (1996) saw this tendency to surface learn as something that was not just present in conventional school but as something that was promoted in professional learning programmes. He was commenting on the assessment structures within medical school that he saw as being focused on measuring learning using examinations systems that only identified memorisation and rote learning. He concluded that abilities needed for clinical practice did not feature highly in the assessment process within medical schools and, as a result, students were not learning properly or fully from their clinical experience, although this was not obvious from their examination results.

This lack of emphasis on linking theory to practice in the training of health professionals was recognised by Crown, who in 1991 claimed that medical education was showing evidence of an expansion of theoretical input without the accompanying link to practice being simultaneously developed. Persons with no background of clinical practice were teaching basic science and were therefore unable to demonstrate to the students the relevance of the subject material for practice. He argued that it was inappropriate that a mostly practical profession should be expecting its students to learn how to be a professional without the benefit of practice to support theory.

Similarly Courtney (1991) and Davies *et al* (2000) were especially interested in the bioscience being taught to nurses on pre-registration programmes. Both studies were carried out within the ten-year period 1990-2000 and confirmed that this important subject could only be of value to students if it was learned within the context of practice. Hislop (1996) was concerned with identifying the need for all nursing theory to be linked to practice. Poor sequencing of theory and practice decontextualised theory, making it difficult for students to recognise when it was appropriate to apply theory to practice.

The comments of the students in the present study mirrored the findings of these researchers. The subject material that they had learned in the educational setting had introduced them to principles of bioscience beginning with the normal and ending with the pathological, despite the fact that they only saw the pathological in practice. The theory seemed to be unconnected and without emphasis on the element of application. They indicated that a deep understanding came about because of experience of bioscience in practice. and the opportunity to think deeply about the experience and its meaning. The negative effect on learning referred to by the students is something that professional nursing courses have often been accused of because they do not adequately combine theoretical learning with the clinical reality (Trnobranski, 1996, Thornton !997, Clancy *et al* 2000, Gresty and Cotton 2003) .

One way of learning about a bioscience topic is to recognise that an event has been seen before, then recall the past situation and discern what it meant. This is especially important in nursing as discrete changes to the bioscience status of a patient often precede more dramatic events (Benner 1984). Detecting changes needs careful and frequent comparison of the past with the present situation and the ability to do this has to be developed experientially. Eraut (1994) recognised structuring information for learning as a form of pattern recognition. This assumes that individuals have many instances available in their memories. These are arranged into categories based on similarities and then form a concept. Individuals tend to make judgements on the basis of the similarity of one situation to a previous situation, often without the awareness of having done so (Eraut 1994).

For the students in this study, the basic principles and concepts of bioscience had been taught in the early years of the course in the expectation that these important ideas would be used by the students in understanding patients' disturbed biology. It appeared that this did not happen until some critical event revealed to the individual student his or her inability to comprehend what was happening. Students then saw their knowledge as meaningless in the present situation, since they were unable to arrange it into any form of recognisable framework. The critical events described in this study seemed to leave the students fully aware of the extent of their own ignorance and also acted as triggers for their learning of bioscience and the beginning of a process of restructuring knowledge in order to transform it into a entity of understanding.

Experienced professionals often use the knowledge of acquaintance to create patterns and concepts, and these concepts can then be used to identify and predict variations in a patient's condition by making comparisons over time (Eraut 1994). Many daily situations are understood on the basis of similarity, an issue confirmed by the findings of this study. Educationalists of the Gestalt school call the recognition of such similarities critical events (Curzon 1995). These are said to have occurred when the student suddenly becomes aware of the relevance of an event. This awareness of the meaning of an event reflects new light on a previous area of ignorance and provides comprehension. However, Gestaltists claim that such insight is complex and is about a situation in its entirety. There is a perception of a fundamental unity in a variety of phenomena and this results in a reorganisation of learning and thinking. Gestaltists belong to the Constructivist school of learning (Dewey 1933, Piaget 1952, Brunner 1960, Vygotsy 1986), which holds that there is a need to structure all learning so that confusions can be transformed into complete recognition.

Constructivists also give much credence to the value of the context of learning and learning about a situation within the context in which it has occurs tends to reinforce learning more than the decontextualised setting of the University.

Learning in a supported clinical environment gave students the opportunity to think deeply about an experience and its meaning. Students in this study favoured interactions with patients in the clinical setting for they found that these opportunities caused them to reflect on what they had experienced. They claimed that this promoted the integration of bioscience knowledge with practice more than any other learning activity they had used. This was something that they claimed had not been introduced to them as a learning approach for bioscience within the educational setting, but they saw this being practised widely in the clinical setting in order to bring about an understanding of what was happening to the patient, prior to making decisions about care and treatment. These approaches assisted them to comprehend their bioscience theory in terms of practice. They claimed such activities allowed them to link theory to practice, to structure information for learning and to develop the ability to reflect. Linking theory to practice is seen as important by Boud *et al* (1976) and Eraut (1994), who stated that learning to read a clinical situation is most likely to be developed by reflection. If reflection does not occur, the student remains locked in with knowledge that they have acquired but cannot use. Studies of practitioner expertise in health professionals have identified that reasoning both backwards (from solution to data) and forwards (from data to solution) encourage reflection and discussion and are a mark of expertise (Norman and Schmidt 2000). Creedy *et al* (1992) sees these stages as part of PBL's approach to learning. She says that PBL encourages students to discuss their experiences and become active rather than passive learners.

Discussion for the students was the opportunity to reflect on the variations found in the patient and, at the same time, assisted in creating the many-faceted perspective that is the basis of concept formation and ultimately an extensive knowledge base. The sharing of an experience and its review with other qualified professionals allowed the students to begin to build up the principles of bioscience around experiences that were problematical to them. When confronted with a new situation, the students sought new information to supplement their understanding. Reflection on their experiences caused the students in this study to, create and clarify the meaning of these experiences in a deliberate attempt to understand them (Boyd and Fales 1983, Rolfe 1993). The idea of discussing and reasoning in order to achieve learning is advocated by Brunner(1960). He believes that students must confront problems and seek solutions to these difficulties in small group settings so that they can create a meaningful learning experience. Although Brunner was of the Constructivist school of learning his suggestions for student learning are mirrored by the

Humanist school of the 1990s who supported students working together and being motivated by the team effort.

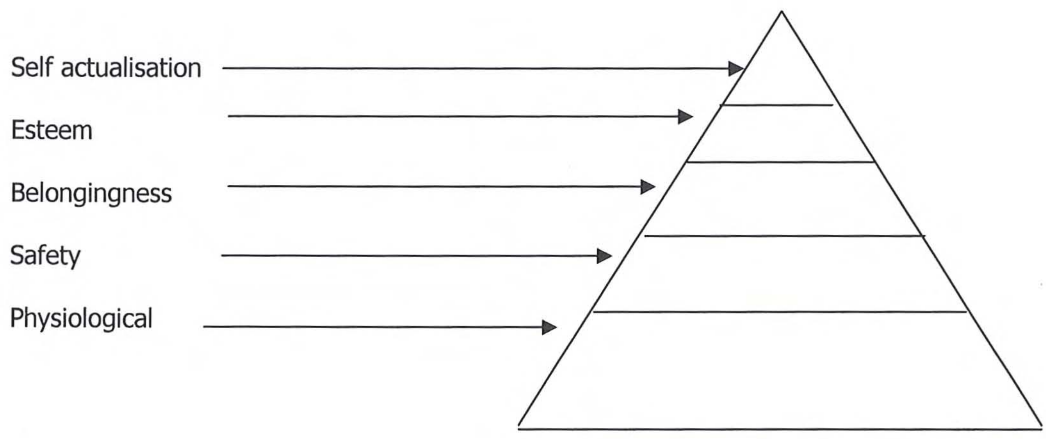
Processing knowledge means bringing it to conscious thought in order to give it attention and reflection. Reflection can penetrate deeply into a knowledge base and bring that knowledge under critical control. Professionals learn on the job but what is learnt needs to be deliberated upon so that professional knowledge becomes integrated into experiences. This means that different ways of thinking have to be developed in order that patterns of disorder can be recognised in the clinical placement and understood (Kolb 1984). For learning to become meaningful, it has to be processed (Ryle 1949).

It appeared that the students in this study frequently sought out opportunities for discussion in order to verify, clarify and evaluate critically what they had experienced. Reflection assisted in structuring knowledge, allowing it to be linked to practice. These two activities appeared to be so tightly interconnected that it is difficult to explain them in isolation. Nevertheless Peirson (1998) contends that learning new knowledge in the context in which it occurs fosters its retrievability and use when there is a need to understand and interpret similar situations. She argues that a student's initial learning within an educational establishment is often overcrowded, and sacrifices a professional's practical needs to academic learning.

5.1.3. Emotions

Theories concerning learning make reference to motivation to learn on the part of the students (Hunt 1971, Barrows 1986, Norman and Schmidt 2000, Dammers (2001). Huckaby (1980) identifies motivation as a variable that influences learning while Woolfolk (1990) describes it as a natural tendency to pursue interests and to exercise capabilities. The idea of motivation contributing to learning has grown out of the work of Maslow in the earlier part of the 1940s. Maslow concluded that healthy individuals were always seeking fulfilling experiences. He described seventeen propositions that he incorporated into a five-level hierarchy of needs. He identified the highest level, self- actualisation, as the need in all individuals to develop one's potential and capabilities.

Figure 5: Maslow's hierarchy of needs



Adapted from Child (1986)

Self-actualisation was seen by Maslow as a form of growth, and growth was the result of a never-ending series of situations offering a free choice between the attractions and dangers of safety and growth. Using a simple diagram this point can be illustrated.

Figure 6: Safety and Dangers of Learning

Enhance the danger		Enhance the attraction
Safety	PERSON	**Growth**
Minimise the attractions		Minimise the dangers

Adapted from Child (1986)

Figure 60 emphasises the need for learning situations to be appealing to students. Otherwise they will play it safe and avoid learning. The converse situation in which learning is made appealing is more likely to make learning a task that is willingly and eagerly approached. But Maslow also recognised that the environment and the persons in the environment could hinder or enhance a students' growth irrespective of a students' desire to grow.

Cannon (1932) saw this growth within the individual as an external factor that set up a disequilibrium or homeostatic imbalance. Just as the physical body became *sick* if a physical disequilibrium was not resolved, so too would the individual become *educationally sick* and remain in a state of stunted learning if the individual's growth was not satisfied. Cannon claimed that motivation arose out of this imbalance and caused the individual to attempt to regain balance by achieving learning. Many other theorists besides Maslow and Cannon have proposed definitions of motivation (Sears 1940, DeCeccio & Crawford 1974, Child 1984). All of these definitions identify motivation as being an impetus or force that directs a person in a particular direction towards some goal or growth. Motivation is grouped into two classes, intrinsic and extrinsic. Intrinsic motivation is the desire within the person to achieve some particular goal, while extrinsic motivation is the effect of the environment on an individual's goal seeking. DeCeccio and Crawford (1974) linked four factors to motivation. They were arousal, expectancy, boredom and anxiety. Of all of these anxiety was the most important in the clinical setting. Anxiety is composed of many elements, of which sadness, nervousness, anger and frustration are nominated by DeCeccio and Crawford in Huckaby (1980). The clinical setting is a complex one in which many responses are possible for a given situation. This means the likelihood of choosing an incorrect response is measurable. The effect on the student is to bring about an increase in their anxiety but it is this very anxiety that should also cause the student to perceive the need to learn (Huckaby 1980).

More recent studies into the effect of anxiety on student learning include those of Jordan and Potter (1999), McKee (2002) and Kalaca *et al* (2003). The latter identified anxiety as having such a negative effect on medical students in relation to their performance of clinical skills, that it became a barrier to their learning.

This anxiety was exacerbated by traditional methods of teaching, and the crowding of subject material within the curriculum. Kalaca's study used a questionnaire in which fourth year medical students were asked to identify situations that caused them to feel anxious. Students identified making incorrect decisions about the treatment of patients as being the most fearsome. Decisions concerning the treatment of patients would be based on an understanding of bioscience as it presents in clinical practice and failure to understand the bioscience would contribute to students' anxiety. The study concluded that the anxiety that the students highlighted was at least in part the consequence of a failure to understand bioscience theory for practice sufficiently.

Research into student nurses led the researchers to conclude that these students also experienced a disproportionate level of anxiety in relation to their study of biosciences (Jordan and Potter 1999). It was suggested that many educational establishments in the 1980s had interpreted the UKCC's recommendation to focus on health as an invitation to teach bioscience without mentioning disease, and this had inadvertently created a barrier to learning. This study is supported by the earlier research of Nicoll and Butler (1996) into the perceptions of Diploma of Nursing students concerning their learning of bioscience. They used the delphi technique and a series of focus group evaluations to obtain data from 69 students who were followed through 8 months of their first year of training. The study highlighted students' concerns on pre-registration courses about the sheer volume of material that had to be learnt and understood. Poor links between theory and practice were also pinpointed along with the teaching approaches that were identified as being the traditional methods including lectures.

McKee (2002) also focused on the bioscience part of the programme in nursing. She too found that anxiety was an impediment to student learning, along with the quantity and the level of bioscience taught but she also questioned the effect of poor study skills and their secondary effect of reducing motivation for learning. McKee distributed questionnaires to a total of 201 students at the end of their first year and obtained a response of 59% (n=119). The findings of the study suggested that widening access to courses had resulted in many students coming on to the programme with different background experiences in bioscience. While maturity itself was not shown to be detrimental to academic success it was shown to be detrimental to the learning of bioscience. She concluded that approaches to learning this subject would have to change in order to increase motivation and encourage the students to accept a greater responsibility for their own learning.

Nicoll and Butler's (1996) use of consensus methods may have led to difficulties in obtaining accurate data for this research. The delphi technique and focus groups are often accused of forcing individual participants to conform to the group and, as such, the true effect of anxiety for the students could have been distorted. Similarly one can find shortcomings within the data collection methods for Kalaca and McKee's studies as questionnaires using mostly closed type questions were used. Closed questions do not allow the respondent to explain freely and fully how they feel or think. However all these different studies from the different educational establishments do support each other in identifying anxiety as having an inhibiting effect on bioscience learning. It is also of note that all these studies were carried out in educational settings where learning was achieved using didactic approaches and where assessment strategies were designed to test such learning. In these settings anxiety does appear to act as a barrier to student learning.

Vernon (1969) saw the professional setting as being a centre for learning and a fundamental form of motivation. Professionals have a great need to be protected and supported by their peer group. This involves belongingness and loyalty, although not necessarily all at once. Festinger (1979) described such a setting as a reality that forced professionals to bring appropriate cognitive elements into play, with the outcome of that play being learning. Support for Vernon's analysis is found in Festinger's Theory of Dissonance. Dissonance was explained as a form of inconsistency that Festinger claimed could make a person feel uncomfortable. This discomfort acted as a motivator and attempts to reduce discomfort could result in learning.

In Child's theory, tension drives an individual to seek actively to understand something that is disturbing them thus once an activity has begun the individual can begin to learn and when the learning is complete, the tension is reduced. Seeking to reduce a tension as described by Child is closely paralleled by Festinger's theory of reducing a discomfort or dissonance. He refers to this discomfort as Cognitive Dissonance. Cognitive Dissonance will motivate a person to seek to reduce or even avoid to a situation altogether if it creates too great a feeling of dissonance. Dissonance is related to cognition (Festinger 1979). Cognition includes what is known and understood about an event in the clinical setting and can involve elements that produce feelings of sadness, happiness and so on. Cognitions are based on the reality of what a person actually does and feels with regards to what is present in the environment.

Motivation could therefore make a very positive contribution to student learning whether it arises from within the student as an intrinsic source or whether it is stimulated by extrinsic factors such as the practice setting. Evidence for the effects of motivation on students using PBL is sparse and conflicting. Although some research claims that harnessing motivation is a key feature of PBL (Berkson 1993, Schmidt 1993, Kaufman and Mann 1997, Paganus *et al* 2001). Others are more reserved in their judgements and call for more evidence from bfurther from further research (Thomas 1997, Berkel and Schmidt 2000).

5.1.4 Effects of motivation on learning

The participants in this study admitted to having experienced intense emotional feelings in the presence of patients and other professionals. The emotions felt varied, sometimes with several emotions being experienced at one time. Students nominated happiness, sadness, frustration, satisfaction and fear as some of those commonly felt. When it occurred emotion was usually triggered by a specific event or critical incident that involved a patient and the student together.

Anxiety is a factor that influences motivation and most affects the individual in contextual settings such as the clinical placement (DeCeccio and Crawford 1974). For the students in this study, it was their lack of understanding of bioscience knowledge as it was encountered in the clinical setting that made them anxious. The effect of critical incidents was to intensify their anxiety to the point that there was within the student a full perception of the need to know. This created a driving desire to explain what had been witnessed within the incident as soon as possible. Anxiety therefore became a motivator for learning rather than a barrier. This finding opposes the interpretation offered in recent studies by Jordan & Potter (1999), McKee (2002) and Kalaca (2003) all of whom identified anxiety as an inhibitor of learning. McKee's study was especially focused on the bioscience component of the Diploma of Nursing programme. She used examination results from one group of students as one of the data collections to assess the impact of this subject on their learning. Although she identified anxiety as one of the negative factors for learning she also found that poor study skills and the use of traditional teaching methods intensified anxiety. Jordan and Potter (1999) referred to the negative effects of anxiety on learning for this subject but they identified that the anxiety was not confined to the students but to the teachers who lacked the knowledge and preparation needed to teach this subject. In both of these studies students leaned bioscience in a traditional educational setting where lectures and skills laboratories were the usual learning environment. Kalaca's study into medical srtudents showed that student's were afraid of making mistakes with respect to their patients in the clinical context and blamed the lack of integration of science theory and practice. However non of these studies made reference to other emotions felt by students while in the clinical context. The findings from this study imply that multiple and varied emotional factors confront students in the clinical setting and it is this dynamic mixture of feelings that pushes their learning.

The psychological theories of Vernon (1969), Child (1986), Festinger (1975) and Woolfolk (1990) concerning motivation support the findings of this study. Woolfolk (1995) describes motivation as a natural tendency to pursue interests and to exercise capabilities, and in so doing to achieve learning. Being motivated made finding out the meaning of a critical incident in itself rewarding for the students. To know and to understand something that aided in decision-making involving patients produced a sense of satisfaction and happiness. Similarly, in his discussion on motivation, Child (1998) suggests that this desire to learn is an instinct or tension that has to be reduced. Child's description of motivation as being a tension shows a great similarity with that of Festinger's Theory of Dissonance (1975), in which he calls motivation a discomfort. Those who experienced these feelings seek to lessen their intensity and, in this study, students achieved this by learning.

The cognitive elements relevant to the students in this study were those in the clinical setting, which demanded the application of bioscience to the critical incident as it unfolded before them. If the students did not know these cognitions and how they all linked together to explain the current clinical setting, then dissonance occurred. The greater the degree of dissonance, the more intense was the desire to reduce it. In this sense tension, discomfort and dissonance can all be described as motivators for student learning, since all these feelings influence learning (Huckaby 1980). When they occur in conjunction with a critical incident, as in this study, the effect is an acceleration of learning.

This leads to the conclusion that patients and events in the clinical setting posed many problems and worries for the students in terms of their understanding of disordered bioscience. The students recognised the gap in their learning and the anxiety that it provoked in them, and they set about finding other ways of eliminating both their worries and their learning deficits. The motivation to learn about events that had taken place led to periods of reflection and group discussion, using realism and multiple perspectives. Such activities are said to feature in a learning style that is problem based (Taylor 2000, Snowman and Beihler 2000) and this in turn links to the beliefs of Constructivist theorists such as Brunner. Students affected by their emotions also sought the support of their peers with whom they discussed these issues and this is identified as a element of Social learning theory.

5.2 Critical reflection on the findings emerging from the qualitative methods

On reflecting on the findings that emerged from the data three issues assumed prominence. They were:

a. the similarities with the findings of this study for the learning of bioscience and other studies into professional learning.

b. the features of the clinical context that could be used to form the framework of a professional curriculum.

c. the changes that learning in context produced to the students' learning style.

a. Many studies by other health care researchers have identified the clinical setting as being the most important situation for students' learning. Whichever subject had been focused upon for their research, the outcome was the same that the clinical setting promoted students' learning of that subject in a strikingly positive manner. This study focused on the subject of bioscience and the findings implied that bioscience learning was equally strongly influenced by the clinical context something that no other studies have identified to date. Despite the arguments for scientific learning being different what this small study has achieved is confirmation that bioscience learning in the clinical setting is not different from the learning of any other professional practice subjects. The factors in the practice setting promote all professional learning. Thinking about this alone has led me to concur with all the other researchers that learning to practice in a professional capacity is best done in a professional context. In all I have not discovered anything new about the value of the clinical context for professional learning. There has merely been a reiteration of its importance.

b. The second issue related to the curriculum framework. At present there is much concern about the bioscience curriculum and how it should be taught. The theory practice divide remains and it is being suggested within my own educational establishment that the best way of dealing with this is to implement a problem based curriculum. Problem based curricula have been attempted by some of the UK medical schools but there is limited feedback. Nursing programmes have also attempted to introduce problem based learning to some of the modules but again there is only minimal feedback and none to date has focused on bioscience. Many of these programmes use hypothetical case based studies for the problem solving activities. But consideration of the work of Barrows, who first developed PBL, raises concern since Barrows himself did not rate the hypothetical case studies as being the best way to teach problem solving skills to students. In his hierarchy of problems diagram (p66) he relegates this approach near to the bottom of his list. So it seems as through a PBL curriculum that is heavily reliant on the use of hypothetical cases to promote problem solving is not as supportive of the student learning as it could be. Such a curriculum may require considerable modification if it is advance students' problem solving skills and hasten learning.

However learning in the clinical context has implications for curriculum development. The clinical context that the students in this study identified with showed clear links with Constructivist, Humanist and Social theories into curricular issues. These links included activities such as reflection, team learning and support, opportunities for review etc. Learning to nurse should therefore benefit from a learning framework based in the clinical context exclusively where links to Constructivist, Humanist and Social learning already exist.

When the project 2000 type training was introduced in the early 1990s great emphasis was placed on course theory and practice being given equal weighting in terms of learning hours. But in reality this means that students have less time available to spend in clinical practice than they did in the previous training programmes and therefore are more likely to have learned less of experience value at the end of their course. Project 2000 was seen as a way of creating more academically able nurses and although it may have achieved this in terms of examination passes it does not seem possible that it could have achieved more clinically able nurses following a reduced hours programme. A clinically able nurse would have to have to spend more time learning in the situation and this is only likely to happen if future nurse training is situated in practice rather than in academia as now.

The *theory hours* of the current programmes have tended to be situated in the traditional educational setting where lectures and skills have been given in isolation from the clinical context with the result that opportunities to link the two have not been there. However, the clinical assessment of a patient/client includes many aspects of a patient situation such as a social and psychological profile, communication skills, ethics, plus past history and current medication to name but some. If bioscience is best learned for practice within practice it seems reasonable to assume that all the other related subjects would benefit from being learned in the same way. Any attempts to introduce PBL into the curricula should consider how learning for the entire programme could be enhanced by the context. If the findings of this are to be believed then PBL has to be a contextual learning activity. Despite the advantages this would provide for a students' learning for practice it is not possible that such a curriculum innovation would be considered. I had to acknowledge that a curriculum situated in practice might be the ideal but it would be difficult to achieve due to the monetary constraints placed on the NHS Hospital Trusts and Universities at this point in time. My own educational establishment is about to begin the process of introducing a PBL curriculum for nursing but it will not be situated in context and will make much use of the paper based cases in an endeavour to achieve problem solving skills in students. It remains to be seen whether this will prove to be a positive learning venture.

c. The final issue related to the learning style of the student. It seemed that initially students on a professional course used the learning style that they developed during prior learning. For many students this was the learning style of their earlier school days, where the dominant pattern is said to be that of a reflector/theorist (Honey and Munford 1986, Knowles 1990, Savin-Baden 2000). Reflectors tend to ponder and observe experiences while theorists prefer to remain detached, analytical and logical. There is a tendency with both these learning styles for the students to demonstrate minimal involvement in a situation.

Professional courses involve the activity of practice and students on these courses need to shift their learning styles from the more passive style of their previous studies to that of the more active. Past investigations into the learning styles of nursing students suggest that students do change their learning styles according to the subjects being taught and the instructional technique being used (Rampogus 1988, Sutcliffe 1993, Rakoczy 1995), but such a shift brings conflict and dissonance. Some students in this study claimed to have adopted a different strategy in order that bioscience that was informing to their practice could be learned. The need to develop a different approach to learning was recognised by the students in this study themselves when exposed to *real* patients in the context of the placement setting. The use of patients encouraged students to seek out new information concerning disordered bioscience because their traditionally acquired theoretical knowledge was inadequate and a new active knowledge base had to be constructed. The students recognized that clinical practice was where real bioscience was to be seen, in contrast to textbook descriptions. This realism promoted their learning and encouraged them to begin the development of a new, more active, learning style that enabled them to learn bioscience for practice while in practice.

The processes that students in this study adopted to understand the information they required included:

- self- directed studies
- small group discussions with peers and other professionals
- reflective techniques

They were motivated to use these processes to achieve learning by the emotional reactions triggered in them because of their clinical experiences, especially those provoked by critical incidents.

In his theory into PBL Barrows (1986) identifies four processes as crucial in problem-based learning. They are:

▪ Structuring knowledge for for clinical practice	involves	carrying out clinical tasks in clinical settings, learning science in practice
▪ Clinical reasoning	involves	data analysis, inquiry, decision making, problem identification
▪ Self directed learning		
▪ Motivation for learning		

If the behaviour of the students in this study is mapped to Barrows' work on problem based learning the following illustration results:

Table 8: Relationship between Barrows' findings and the current study findings

Learning Factors Barrows' theory of PBL	Processes identified by students in this study
Structuring knowledge for clinical practice	Assessing patients Reflective techniques Thinking about presented patient physiology
Clinical reasoning	Questioning, small group discussion with peers, patients and other professionals,
Self directed learning	Self directed studies
Motivation for learning	Emotions

From the findings of this study, the initial factors in the clinical setting that promoted the learning processes were the patient and other health care professionals. The patient in the clinical setting proved to be problematical for the students. The students begin to question the bioscience that they saw in its disordered form and new issues began to emerge, while others became more clearly defined. Most of the problems encountered by the students involved individual patient cases. The students were obliged to reflect and integrate what they knew into a cogent explanation, of the clinical situation and, where they did not know the explanation they were motivated to find out about it by the emotional factors present in the situation. This finding out was a mixed activity at times carried out alone and sometimes with peers and other health care professionals. In both cases, the constant revisiting of the subject initiated a circle of learning of bioscience that informed their practice and promoted the integration of bioscience aspects across the spectrum of disordered to normal. It appeared that the students who claimed to understand bioscience in the clinical setting had adopted a form of problem-based learning for the study of this subject.

Problem-based learning is defined as the analysis of a problem situation to acquire knowledge (Baillie 1998). A problem situation requires knowledge from different sources to be brought together and this process enhances student learning. In problem-based learning, students are prompted to use a wide range of information to link together an understanding (Savin-Baden 2000). The situations which best foster problem-solving are those that are situated in a realistic context. In such situations the starting point for the learning should be the problem (Boud and Feletti 1991).

Problem-based learning techniques required a genuine intellectual effort on the part of the students and had to be practised and perfected through feedback from patients, peers and other health care professionals in order to be fully developed as a learning strategy. Students in this study identified the patient as their problem because the patient exposed their own ignorance of bioscience for practice. But they were also aware of the contribution of other professionals to their clinical understanding through discussion, reflection, practice and reading within the clinical context. Here the opportunities to learn were constant and available to any student who chose to use them thus their learning was encouraged. I believe that the encouragement to learn must have been considerable and in order to achieve this learning the students must have had to develop different ways of dealing with all the new information that was met. It is possible that this change to their learning can be shown and maybe even measured. If the students have shown a greater leaning towards PBL then examination of their learning style over a period of time should show changes? When rethinking the three issues, one issue appeared the most amenable to further scrutiny and that issue concerned the learning styles of student nurses. Identifying a learning style that promotes professional learning might be useful. If the students' learning style is shifting towards problem solving as an effect of their clinical experience during their first year of study especially, then taking steps to promote that shift from the first day of the programme could be developed within any curricular framework.

Therefore the aim of the second part of the study was to explore in greater depth the concept of learning style and the changes to a students' learning style brought about by clinical practice with their co-operation throughout their foundation year.

Summary

Through direct interactions with patients in the practice setting students achieved much learning of bioscience. Active engagement with real problems gave a relevance to the students' learning and a strong motivation for learning was created by the emotional response of the student to the patient. Patterns of disorganised bioscience could be recognised in the clinical placement and understood, but different ways of thinking had to be developed in order to achieve this. The use of patients in the real setting appeared to activate a problem-based approach to the learning of bioscience and suggested that the students in this study changed their learning style in order that learning that was useful in practice could take place.

CHAPTER 6

INVESTIGATIONS OF LEARNING STYLE

6.0 Introduction

The findings emerging from the first part of this action research study indicated that students' learning was affected by the clinical setting, the presence of the real patient and the emotional factors generated when the three existed together. Students claimed that they relearned this subject beginning with the abnormal bioscience that they were presented with in clinical practice so as to reach a comprehension that was informing for them. Evaluation of the findings suggested that if students had to relearn this subject using the promoters for learning which they themselves identified from within the clinical setting the implication was that they must have adopted different strategies to enable their learning.

Vermunt (1992) saw a collection of persistent strategies used by a student to assist their learning as forming a learning style. Adopting new strategies for learning this subject using the identified factors from within the clinical setting suggested that students might be adopting practical learning strategies. Being concerned with the practical and with utility is known as pragmatism. Honey and

Mumford (1986) identified a type of learner who they described as more interested in the practical and realism and whom they called a Pragmatist. Pragmatists liked real life situations where they could concentrate on practical issues, try out techniques and link subject matter to the problem. Clinical experience includes all these attributes and could cause changes to the students learning style that were of a more pragmatic nature. This was a very important revelation since the second major aim for this study was to attempt to use the findings from part one of the study to develop a better strategy for the teaching of bioscience. It had not been anticipated that the initial findings would suggest that the learning style of the student would have to change in order to learn bioscience. But, if this is what happened to a students' learning because of the placement factors then it would be valuable for the teacher to be aware of this so that teaching strategies that utilized the clinical placement could be introduced early in the programme and persist throughout.

Optimising the learning opportunities offered to students in order to ensure that students achieved maximum learning is especially important for any nursing student (Hodges 1988, Cavanagh *et al 1994*, Zhang 2000, Snelgrove and Slater 2003) but for the subject of biosciences which is regarded by most students as a difficult subject to learn (Jordan *et al* 1999, Davies *et al* 2000, McKee 2003) it is even more important. The development of a approach that optimises student learning of bioscience requires an explicit knowledge of the processes that influence the relationship between the students' learning of the subject and the environment in which the subject is encountered (Entwhistle and Ramsden 1983, Kolb 1984, Cowman 1995). The first part of this study revealed the processes that influenced students' learning of bioscience now it was necessary to study the effect that the processes had on the development of a style of learning that facilitated bioscience learning from the start of the professional programme. It is very clear from the data that the pressure to relearn bioscience became evident to the students soon after they entered the clinical setting and that the pressure was considerable. Reasoning about these findings suggests that the process of change to their learning style would take time and should be detectable if measured at intervals over time with the use of suitable measuring device. With this in mind the intention of the second part of the study was:

- to explore the concept of student learning styles through the literature
- to test the hypothesis H_A that for this group of students:

  there was a change in their learning style for the subject of bioscience during their first year of training.

6.1 The concept of learning style

Learning styles are defined as individualised preferences, tendencies or distinctive behaviours which influence learning (Smith 1984, Entwhistle 1988, Brink 1988, Lapeyre 1992). Messick (1976 p 38) defined learning style as the ways in which information and experience are organised and processed by the individual. *'They are conceptualised as stable attitudes, preferences or habitual strategies determining a person's typical modes of perceiving, remembering, thinking and problem solving'.*

Vermunt (1992) called the habitual strategies a student employs consistently to learn about a subject, a learning style. He proposed four types of learner whom he called the undirected, the reproduction directed, the application directed and the meaning directed. Cognitive psychologists view learning styles as a collection of information processing strategies that are influenced by the personality traits of the individual. Marton and Saljo (1976) refer to student learning styles as being of a deep or surface orientation whereas Pask (1976) describes holistic and serialistic styles. Schmeck (1983) lists four types of learning style named as deep processing, elaborative processing, fact retention and methodical study. Kolb (1984) also identifies four types of learning styles, the divergers, the accomodators, the convergers, and the assimilators while Biggs (1987) sees surface, deep and achieving learning styles. It appears that a variety of interpretations exist about how learning occurs and they vary according to a particular theorist paradigm. But whatever the definition ascribed to the idea of a learning style all of them identify a distinctive behaviour pattern within the individual that is concerned with learning. In addition Hoeksema (1995) claims that a learning style is not just about the about the collection of strategies that students employ to help them learn but it was also about motivation and personality. Even Ramsden (1988) who describes a learning style as a collection of general strategies used by students to bring about learning drew attention to the idea that these strategies are subject to complex interactions between the student and the learning environment.

Some important studies concerning the complexity of learning that link to the ideas of Ramsden come out of the research of Marton and Saljo (1976). They used 40 female students in their first year of university studies. The students were divided into two groups randomly. One group became the experimental group and the other the control. The experiment involved the students reading a complex article and answering a series of questions that were linked to approaches to study by the students. The results indicated that what the students learned depended on the test at the end of the study period. Students would spend time reviewing past papers and looking at sample answers to previous papers then they adjusted their learning to achieve a pass grade. Where superficial questions and short answers were required they tended to surface learn but where the test was of an essay or project type they tended to adopt a more in depth learning style. Some students appeared to have difficulty adjusting from using a surface to a deep approach and this led Marton and Saljo to suggest that they had become *technified* by years of successful surface learning and were most likely finding it more difficult to change. Being *technified* to a surface learning style became an impediment to future learning. Svensson in 1977, using the same group of students as Marton and Salio was able to show that it was those students who adopted to the deeper learning style who were the most successful in passing their examinations. It seemed that to change the learning style involved the student in actions that brought about a sharp refocusing of their attention on the subject to be learned. Despite the limitations created by using small groups of students and using students who were not on a professional training programme, the validity of the findings of the above researchers was supported by the subsequent studies of Biggs (1979), Entwhistle and Ramsden (1983). The last two mentioned studies took place in a variety of academic and institutional establishments and although the researchers used different words to describe the learning styles of the students, they clearly identified students who used a superficial approach (surface learners), those who learned more deeply (deep learners) and a third group who were described as using a strategic or variable approach. Newble and Hejka (1991) saw the learning strategies of this last mentioned group of students as being motivated principally by assessment. In order to pass their examinations they would use any strategy that they believed would allow them to achieve good grades with the result that their learning style was unstable. Although students using the latter approach to learning often obtained high marks they demonstrated little or incomplete understanding of the subject material. This led the researchers to the conclusion that students displaying a variable learning style did not have learning strategies that would eventually led to an identifiable learning style. These students tended to do what they were instructed to do by the tutor and in 1994 Richardson pointed to these students' behaviour as evidence that the presence of a strategic style is unsubstantiated. Kember and Leung (1998) offer support to Richardson' statement that the achieving style has not been as clearly identified as the other two styles by pointing to differences in the ways that this style was categorised in the earlier studies of Entwhistle and Ramsden (1983) and Biggs (1987) and to the lack of evidence for such a learning style in any of the qualitative studies on teaching and learning to date. However this does not mean that such an orientation to learning does not exist just that the characteristics that would allow it to be measured have not yet been clearly defined and much more research is required into this issue. Some of the most recent research into learning styles using a cross sectional design indicates that the strategic learning style is prominent in students in secondary school but appears to have faded by the time a student reaches higher education in university (Klatter 1996, Roosendaal and Vermunt 1996). Again studies into the learning styles of higher education students are very limited and there is nothing that gives any insight into how a learning style develops and stabilises over the duration of a programme.

However, studies into learning style did expose other issues concerning learning. Some of these arose from investigations into the learning behaviour of medical students in a traditional establishment in 1983. Vu and Galofre found that medical students as a group obtained higher scores on the surface learning style and lower scores for using a deeper learning style. Comparing these findings for learning style with other faculty students doing art or education at the same establishment revealed that medical students were the most prolific users of surface learning styles. These findings were supported by the later works of Biggs and Kirby (1983) and Newble and Gordon (1985). Criticism of the student for the learning style used may be unfair for it can be argued that traditional establishments tend to rely heavily on lectures with supplementary laboratory work, tutorials and ward work. Assessment is heavily weighted towards examinations containing a proportion of multiple choice questions (MCQ). The educational establishment could be accused of driving the student towards surface or strategic learning styles so suppressing the development of more productive learning styles (Schmidt *et al* 1987, Sutcliffe 1993,). Some additional evidence for the development of different learning styles in students came from studying how students learned in two different medical schools, one following a traditional approach and the other a more self directed, problem based approach (Newble and Clarke 1986). Traditional medical schools tend to rely on a curriculum that is taught by lectures, supported by tutorials, practicals and ward work. Assessment is largely based on examination that includes multiple choice questions. In contrast problem based schools use small group teaching methods and the individual student spends more time in self-directed study. Problems are centered around patients within clinical and community areas. Assessment involves the use of multiple methods and there is a greater reliance on formative assessment. The results of the study showed that traditional course students displayed a preference for a learning style that involved reproducing over all the years of the programme. Students in the problem based programme showed a greater preference for a learning style that permitted deep learning but these findings were only significant in the first and the third years of the new programmes. The fact that the findings were not clear cut for learning styles pointed to constraints within the assessment system and the accusation that despite the curriculum changes the assessment was still driving the student towards the development of a learning style that used predominantly surface or strategic learning approaches. It seemed that the relationship that existed between the student and the learning establishment to which they belonged was more complex than was originally thought. This raises the question that if a students' learning style is dictated by the curriculum and the assessment strategies, then students on professional courses such as nursing, where learning is taking place in two environments, are being driven to develop two concurrent learning styles but only one of these styles is visible in the assessment scores while the other remains unaccounted for.

Another issue that influences the concept of what constitutes a learning style is that of culture. Watkins *et al* (1991) reported a number of studies in which it was claimed that students of Asian origin used learning styles that were characterised by memorisation, rote learning and regurgitation of information. There was an absence of insight and understanding (Murphy 1987, Samualowicz 1987). Additional studies that attempted to disprove or support these statements (Kemper and Gow 1990, Kember 1996) led to the suggestion that a narrow systematic style of learning may be the result of communicating in two languages and used the supporting example of Hong Kong students who used English as a medium for teaching and reading but whose mother tongue was Cantonese. Hence they relied more on memorisation as a way of achieving good grades in their examinations. Although Kember's (1996) study was not able to prove conclusively that cultures in which students used one language for learning and the other for all other daily communications favoured a more strategic/surface learning style, it did expose the inadequacies of the various tools that are used to try and identify a students' learning style since the issue of culture and language were not questioned in any of the instruments used.

The issue of learning in two languages can also be linked to student nurses since they learn in a clinical environment where scientific language is spoken daily in relation to patients/clients and clinical events. Bioscience language in clinical practice would be used in discussing the concepts of disordered bioscience along with abstract descriptions of that disorder. Kempa and Hodgson (1976) rate this level of scientific discussion as high and in order to comprehend what is being discussed at a conceptual level the student would have to have seen many exemplars of the concept. A students' understanding of a concept is unlikely to be instantaneous and may only be achieved after many exposures to examples of the concept but only after the appropriate language has been learned and understood.

Figure 7: Sequence of phases for the development of scientific concepts

Phase		
1	Exemplar	
11	Many exemplars	
111	Concept (Inclusive term for all the exemplars. Directly related to concrete experience)	
1V	Abstract (Generalisation of a concept)	
		increasing complexity and time

Adapted from Kempa and Hodgson (1976)

Understanding of a concept allows a student to move towards the activity of problem solving and towards the abstract level of understanding. However Kempa and Hodgson (1976) claim the maturation of concept formation depends on reinforcement provided by instruction which allows the concept to be refined by the student until the point of full perception is reached.

Most nursing students enter clinical practice not having seen any examples of disordered bioscience and most of them will also have come into nursing without any science background to assist them with the learning of a subject that underpins nursing practice (Rutishauser *et al* 1985, Wharrad *et al* 1994, Byrd *et al* 1999, Jordan *et al* 1999). What they previously learned from books had no obvious connection to what was now being seen and it was being discussed in a language that students did not understand. The significance of these events was likely to have produced a response that resulted in a steady shift away from the learning approaches of the academic establishment and a more towards approaches that facilitated concept formation of bioscience principles that were applicable to clinical practice, but that rate was influenced by the speed at which the student adjusted from one set of concept attributes to another (Kempa and Hodgson 1976). It appears that considerable pressure can be placed upon the students' learning style by the environment in which learning happens in order to bring about a change.

6.1.2 Learning styles of nursing students

Five studies into the learning styles of student nurses in the UK were identified. (Dux 1989, Lapeyre 1992, Sutcliffe 1993, Cavanagh *et al* 1994, Cavanagh *et al* 1995). None of the studies concentrated on learning bioscience but were directed towards the learning of nursing in general.

Lapeyre (1992) says understanding how people learn has concerned man since ancient times and in more recent times this has lead to a number of research studies being carried out into various aspects of learning within nursing related fields (Meritt 1983, Laschinger and Boss 1984, Hodges 1988,Rampogus 1988, Dux 1989, Cavanagh *et al* 1995). These writers claim that a variety of interpretations exist as to what constitutes a learning style and the factors that influence it. A common idea that emerges from all the various definitions is that a learning style is about the individual's tendency or preference or distinctive behaviours that result in them achieving learning (Smith 1984, Entwhistle 1988, Brink 1988)).

Rampogus (1988) had looked specifically at student nurses learning styles. He noted that students implemented particular strategies when faced with a learning task and he concluded that they exhibited no particular style for the task of undertaking learning. He claimed that various factors such as context, the influence of a large number of peers could have caused them to change their ways of learning in order to adapt to new situations. In the same year Dux using the Honey and Mumford Learning Style Questionnaire (LSQ) studied the learning styles of 119 students over a two month period in one college of nursing. She discovered, like Ramsden, that no one learning style dominated and that most students exhibited a combination of styles. Dux named this combined style the *all rounder* and suggested that a student with such a learning style would be amenable to change and would benefit the most from new learning situations. However in earlier studies Pask(1976) defined this failure to use a specific strategy to learn as *globetrotting*. He suggested that *globetrotting* was a learning pathology and evidence that the student was unsure of how to bring about learning and was using inappropriate techniques. He suggested that this was the outcome of overloading a student with information and as a result they were unable to see how theory and practice fitted together. Ramsden and Entwhistle (1981) and Dunkin and Biddell (1983) proposed the view that at least part of the problem lay with the academic environment. Different establishments have different teaching styles and different ways of teaching may be the result of teaching a subject discipline, but it could also be argued that nurse teachers who have moved over from the old school of nursing to the university may be more influenced with maintaining the old role model that they have carried with them than changing to the new context of learning for the student.

Dux then sought to extend her study to determine the preferred teaching style of the teachers. A teaching style referred to a collection of preferred strategies that a teacher would use to enable the student to impart information to students and achieve learning. She obtained a very small sample (n=11). During interviews with the teachers they claimed to be using more progressive techniques of teaching such as small group work, self-directed learning. Subsequent data showed that in practice they had to use more traditional methods and very rarely paid heed to the learning styles of their students when planning sessions. She concluded that teachers need to be more committed to using new ways of teaching not just in theory but in practice. Dux's examination of the teacher' perspective was based on a very small sample which limited the opportunity for the findings to be generalised but they did draw attention to the fact that teachers were not giving consideration to the learning style preferences of the group and therefore not maximising the learning opportunities.

Students developed stable styles of learning as the result of repeated exposure to the situational requirements but that also implied that this may take some considerable time (Pask1976, Eraut 1993). Pask was concerned as to whether this stability of learning style would happen for student groups who exhibited a variation in approach to their learning according to the context of the learning. He suggested that perhaps some students did not develop a stable style for their learning at all. If this instability is the case for nursing students then its early recognition would be important as it would favour the introduction of strategies that produce a positive learning style for bioscience learning early in the programme since according to Dux this student group would be the most amenable to new learning experiences.

Earlier studies by Hodges in1988 in the US attempted to assess the learning style of students entering nursing. Her study used Kolb's learning style inventory to test the preferred learning styles of 65 students aged between 18-21 years of age entering nursing for the first time and compared these findings with the learning styles of 28 students also entering nursing for the first time but who were in the older age range of 22-54 years. Kolb's learning theory was based on an experiential cycle and described the learning process as taking place in four phases which he identified as;

1. concrete experience
2. reflective observation
3. abstract conceptualisation
4. active experimentation

From this Kolb identified four major learning styles

1. the diverger
2. the accomodator
3. assimilator
4. the converger

Hodges found that all Kolb's learning styles were present within both groups but the dominant learning style by just 2% was that of diverger. Divergers like concrete experience, reflective observation and are often people orientated, characteristics that would be useful to them in the practice side of the profession (Rampogus 1988).

All the studies carried out to try and determine the learning styles of student nurses have reported a wide range of findings (Cavanagh *et al* in 1995). Cavanagh's own study which sought to determine the learning styles of student nurses on first entry to the programme supported the findings of Hodges. He too found the difference between the occurrence of different learning styles to be of no significance but again the diverger style showed a small lead (1%) over the other styles. These findings created quite a quandary for it had been hoped to be able to use the information obtained to use teaching strategies that would enhance the learning for the students and now there was no definite evidence to support the implementation of such changes (Cavanagh and Coffin (1994).

Kolb (1984) believed that the professions themselves would have a considerable influence on the individuals learning styles and that learning styles would develop according to the demands of the profession. He acknowledges a special link between the professional environment and student learning styles. This statement is supported by the work of Pask (1976) who looked at the concept of serial and holistic learning by students. He saw serial learning as surface learning while that of holism matched deep learning. He suggests that students only become deep learners after they have spent some time surface learning but the movement from serial learning to holistic learning may be variable in students and the best way to achieve holism in learning is to teach the student how to learn. So it seems that exposing students repeatedly to situations that show them how others think in practice and, involving them in the business of problem solving for patients in practice could lead to the formation of a learning style that is not only effective but promotes deep holistic learning.

Sutcliffe (1993) claimed that the problems students had with their learning styles were because of the dictates of the teachers. The latter needed to examine their practice. The purpose of all education was surely not just about the end product of professional qualification but about the students' growth and development and this could only be achieved if consideration was given to the learning styles of the students for a particular subject. Sutcliffe used Beattie's (1987) classification and categorisation of subjects within nursing to devise a semi structured questionnaire which he administered to 30 nurses who were students on a post-registration course. Only five students returned the questionnaire so Sutcliffe used the replies as a basis of an interview schedule and set about interviewing 30 more nurses on the same programme. Some of the questions on the interview sheet were specifically focused on the subject of bioscience.

The findings indicated that as a group the students preferred a convergent learning style in which they could adopt a passive stance to the learning of bioscience. Surcliffe questioned whether this was the best learning style for this subject and suggested that if past experience of learning this subject had always been in the educational setting where the lecture had been the teaching tool that had been used predominantly then the students would not have known another way of learning bioscience. He asked the question, if students are taught this subject another way will they develop a different learning style? This finding opposes the suggestion made by Knowles (1984) that adult learners bring with them a wealth of experience that they will use as a resource in a new learning situation. If their past experience was negative it is more likely that there would be reluctance to learning this subject, which important as it is for patient understanding, remains one that is difficult to comprehend. There is also the question of what happens to the many students to nursing who have no science background but considerable learning in the social sciences. Is it not more likely that they will attempt to adopt a learning style that is suitable for those subjects but not useful for bioscience?

However Sutcliffe's study also asked students about how they came to understand abnormal bioscience including medical diagnosis, treatment and nursing care. Here more students showed a greater preference for the patient case study in which observation, reflection and questioning could take place.

There was an impression that students compartmentalised the subject so that when they left the classroom for clinical practice they left behind the theory learned in the lecture rooms and the skills laboratories and saw bioscience not as a normal science as taught in the classroom but as a disordered function within their patients. This separation is the basis of a gap between theory and practice and has been identified in other subject areas within the nursing programme (Orton 1981, Gott 1984, Melia 1987, Quinn 1988).

Sutcliffe's study was limited by the small number of participants (n=30) And although it did not look particularly at the individual learning styles of the students it did question whether a student uses varied learning styles and varied them according to the subject studied. Despite this difficulty the findings of Sutciffe can be tied to Kolb's statement that learning in occupational disciplines is a positive experience for students producing learning styles congruent with the subject. It is possible that students with an ineffective learning style would be forced by the demands of occupational practice to either change their learning style to achieve practical knowledge of bioscience or drop out of the programme.

Another issue with the nature of nursing according to Sheehan (1980) is that it is not a discipline of knowledge but rather a field of knowledge. A field of knowledge is one in which subject knowledge is drawn from other disciplines of knowledge for example nursing draws on disciplines such as biology, chemistry and psychology to create its knowledge base. Sutcliffe (1993) suggests that students will use different learning styles according to the subject being learned. But, it can also be argued that this will only be true if the student sees learning as separate parts. It is the education establishment that teaches the subjects separately but the practice area is focused upon the patient and applied subject knowledge is seen as an interacting whole. This in turn would demand that the student adopt a consistent and appropriate learning style for all nursing subjects since practice depends upon the ability to use all professional knowledge in a manner that promotes holistic patient wellbeing. It would seem that although the context of learning does appear to influence all learning (Newble and Clarke 1986, Ramsden 1988) some practice settings, such as the clinical setting, may be having a much greater impact on student learning than others. To date all the measure of learning styles and approaches to learning have failed to develop any devise for determining how big this impact is. Since clinical practice may be having a particular impact on the student and their learning and it seems pertinent to consider this setting and the distinctive features therein.

6.1.3 The clinical practice setting

The term clinical experience refers to the actual experience of dealing with patients, their families and relatives and their reasons for presenting in the practice setting. Clinical experience gives the student the knowledge that they need to work with patient/clients and their families successfully. This knowledge is not acquired through academic study and bookwork but by seeing clinical phenomena and dealing with it at first hand. Books often contain scientifically verified knowledge that is recommended for use practically but when tested against a practitioner's knowledge can be deficient. Most students find it difficult to recognise the heart sounds that are made through the stethescope when taking blood pressure from the description given in a book but come to be expert at recognising these sounds through the repeated practice in the clinical setting. They may even come to disagree with the book's description of the sounds heard because clinical practice has ligitimised their claims. All sorts of procedures are expected of students in practice from the taking of basic observations such as pulse and temperature to the more complicated and dangerous procedures of surgical dressings and injection administration. Students are allowed to undertake more and more of these complex skills and interventions as they become more senior in the training.

The very organisation of the clinical setting and the hospital especially presents students with the idea of responsibility by showing them the ranks of organisation not only amongst the staff themselves but also in relation to the procedures that they undertake for their patients. The outcomes of a treatment plan are frequently presented to a student in practice as having consequences and these consequences have penalties that can have a devastating outcome for the future qualified professional. Such ideas as, what should be done if a drug error occurs, a patient has a cardiac arrest, a patient has a grand mal fit in front of you, are situations frequently presented to the student in practice. Students therefore believe that they must learn many things by actual experience and because they are told that experience is compulsory before they have any prospect of becoming qualified so they see this as an absolute must for their learning. There is another aspect to experience that makes this kind of learning impressive to the student and that is what other members of the clinical team tell students about care regimes and treatments that have proved to be efficacious. These treatments may have a weak evidence base to support their use but they work in practice and as a result their use is not barred. There is within the profession a recognition that many nursing problems have not yet been scientifically verified and until such time as this happens many things will continue to take place in practice. Students also notice that many of the facts that they have gleaned from the book or in the lecture hall do not appear in practice and they will hear other members of staff repeat that this particular fact never occurs in practice. This is especially true within the subject of bioscience since even a very basic observation such as pulse may present with many variations of rate and rhythm that are not always considered of significance to the experienced staff member and oppose what the text said. In addition all bodily systems work together within the individual to produce a state of homeostasis. This is a physiological truism and means that many slowly advancing disorders of bioscience may be compensated for by other bodily systems for some considerable time before the change manifests itself. For the students this causes them to discount their previous learning because the text book version never explains such phenomena as compensation but in practice it is a common occurrence and effects how they understand all their bioscience. Clearly students who have such experiences would be inclined to view clinical learning with some considerable respect.

Students meet patients in a variety of circumstances mostly in either the hospital or community setting. In the community patients are not under the constant observation of staff and come and go to their homes at will. Sometimes they do not bother to attend the community venue and they frequently fail to carry out given care regimes and to take medication prescriptions. Their descriptions of how they are faring with their health are often incomplete and since they are not in-patients it is more difficult to verify what has been said as the opportunity for constant observation is not present. This makes understanding of the patients' situation much more difficult for the student and reinforces in the students' mind the importance of learning in context if this situation is to be dealt with successfully by them in the future.

In hospital patients conform generally to the rules and practices of the establishment. The student sees a patient who is controlled in comparison with the situation in the community and this permits observation and learning because of repeated exposure to the patient along with the benefit of the presence of other staff members who provide support and insight into the patients' care needs. The support of others helps the student to acquire ways of dealing with patients who may be mad, violent or critically unwell and this assists them to become detached personally from the situation so that they may learn and understand from a professional standpoint. This is important for student learning as they may be obstructed in their learning if patient interactions in practice are frequently emotionally charged. Clinical practice provides the student with the opportunity to become proficient in speaking and understanding the technical vocabulary that allows them to express themselves in a professional way and not from the perspective of a layman so moving them closer to being part of the multidisciplinary team responsible for the patient's welfare.

Clearly the situation of clinical practice contains several powerful elements that place extreme pressure on a student's learning. These seem to be group membership, the patient and their relatives, fluency of the technical language, the lack of usable bioscience knowledge.

6.2 Instruments that measure learning styles

The instruments that have been developed for examining learning styles have emerged from many studies seeking to identify the most commonly used approaches or dispositions to learning used by students (Entwhistle and Ramsden 1983, Biggs 1987, Schmeck, Geisler-Bernstein and Cercy 1991, Riding 1994). All the instruments are in the form of questionnaires containing two or more constructs for learning. Each construct has a list of sub questions designed to explore the behaviours and beliefs of the student about how they achieve learning. These tools were developed after the examination of relevant theory then tested and subject to further analysis (Kember and Leung 1998). Despite the different number of constructs adopted by the authors for all these instruments only two major orientations to learning persistently demonstrated their existence. These were originally identified in Marton and Saljo's (1976) study that proposed that all learning is either surface or deep and the style that a student used would be made up of a number of actions that would allow them to achieve either of those levels of learning. Some studies have put forward the idea of the presence of a third dimension of learning known as strategic or variable but this dimension has not always been visible within subsequent studies (Ramsden 1979, Entwhistle and Ramsden 1983, Harper and Kember 1989). Richardson (1995) suggested that it is an additional dimension that may be connected to either the deep or surface approach and is used by students intermittently as a strategy influenced by motivation and the desire for high achievement. Harper and Kember (1989) suggest that this learning style is probably variable and only adopted by students who saw their learning environment as unsatisfactory. They claim it is some mix of deep and surface learning but recognise that this mix may be made up of pathologies such as *technification*. Biggs(1993) expressed concern about the failure to pin point the components of this fluctuating learning style. He saw this variance as counterproductive as it could lead to varying interpretations as to what constituted a learning style and a learning process and this could result in the inappropriate use of the instruments themselves.

Further criticisms concerning the main instruments came from Richardson himself. Richardson (1994) questioned whether the structure of the scales was appropriate. The ways that students developed for learning have become of great interest to educational practice and research and therefore the instruments used to identify learning style must be accurate. A number of other researchers have attempted to test the reliability of the subscales (Entwhistle and Ramsdon 1983, Meyer and Brown 1989, Kember and Gow 1990, Richardson 1995) The results of these studies using statistical analysis show variable findings in so much as the Cronbach reliability factor was lower than normal for some of the questionnaires and in other cases the factor analysis for the items on the sub-scales did not match other claims made by other researchers. What all the questionnaires did indicate unequivocally was that whichever methods the student used to learn the intention was to achieve deep or surface learning and that this orientation was consistent across all countries and cultures (Richardson 1995).

Kolb(1984) asserted that professional programmes such as nursing would attract individuals with learning styles congruent with the discipline knowledge and the implication was that this would be detectable in his learning style inventory. But this has not happened according to the critics (Kirby 1976, Bennett 1978, Dunn and Dunn 1985, Brookfield and Brundage 1989). They claimed that up one third of their sample groups could not be classified by learning type and could only conclude that some students showed a persistent variation in learning style which was most likely to be subject influenced. However Smith and Tang(1998) report that there is a fundamental difference in learning styles which manifests itself in different cultures and that learning in another language, in this case the technical language of bioscience, can lead students towards a more systematic and narrower pattern of learning. Provost and Bond (1997) questioned the value of any of the available instruments to detect the acquisition of subject knowledge and academic performance and suggest that there are too many other factors influencing a students' learning for any prediction to be accurate. Zeegers (2001) concluded his study into how students learn science with the comment that too little is known about how the student themselves deal with their learning experiences and that the instruments that are used to evaluate student learning in higher education are not reliable. The implication that emerged from his study was that higher education did not encourage students to learn in a meaningful way and the students' perception of the workload did not necessarily result in a meaningful engagement with the learning materials. It appears that much more work is required in order to devise instruments that can measure learning in different tertiary settings including professional practice.

What was of concern for the present study was that all the instruments identified had been tested and developed over time using students from the conventional educational setting of either school or university. Not only were the findings subject to several forms of sampling bias as the result of small group sampling, the use of only one educational establishment or the use of conventional school students as opposed to higher education and the adult learner, but the majority of studies did not explore student learning in a professional setting.

This study had attempted to identify the factors that assisted learning in clinical practice and the findings had suggested that the learning style of the students had been changed as the result of pressures from within the placement itself. This in turn had enabled new approaches to learning to come into existence and in time allowed the student to form new learning styles for themselves that were more helpful in assisting them to learn in practice for practice. The literature revealed that students did indeed use many strategies to achieve learning and changed these strategies as they saw fit yet the literature also revealed a deficit of studies into how students learning strategies are affected by the practice setting within professional programmes. The second stage of this study sought to explore this gap.

6.3 Detecting changes in the students' learning style

The second stage of this section of the study was to test the hypothesis that:

H_A there was a change their learning style for the subject of bioscience during their first year of training.

6.4 Methods used

This section of the study used non experimental research methods to accumulate data.

Non experimental research is descriptive and concerned with conditions that exist and are developing. (Cohen and Manion 1988, Grimes and Schultz 2002, Polit and Beck 2004). At times they are connected to a preceding event that has influenced the present condition (Best 1970). Descriptive research is also sometimes known as developmental since it is concerned with both describing the relationship that exists within variables in a given situation and in accounting for the changes that occur within these relationships over time. Bowling (2000) described this method of data collection as an analytical survey but also made reference to the moving forward over time as indicating prospectiveness and to the opportunity to collect many sets of data from one group, the cohort. She supported this method for studying trends in behaviour and made reference to the greater degree of precision that could be obtained from the measures gained stating that responses to the same question on successive occasions for the same group could result in positive correlation and a reduced variance of change. The longer the time period used the greater the reliability and validity of the findings. Further support for this statement came from Zeegers (2001), Grimes and Schultz (2002) and Polit and Beck (2004).

6.5 Rationale for the methods used

The early part of this study had identified the presumed causes of bioscience learning in the clinical context and this part of the study wished to chart the development of its presumed effects on the learning style of the student in relation to bioscience over time. This involved observation of the phenomena without intervention. Descriptive research methods appeared apt. Since the change to the students' learning style could only be determined with time, a longitudinal study that was prospective should allow this change to become visible by accumulating successive measurements over an extended period of time and at different points in that time period. One group of students was studied for the entire time and referred to as the cohort.

The research question used here is a hypothesis. A hypothesis is a tentative prediction between two variables (Bowling 2000, Polit and Beck 2004). The first stage of the research did not use the hypothesis because too little was known about what was assisting the students to learn bioscience that was informing practice. So the question was general and aimed at obtaining participant's viewpoints. The outcomes obtained revealed that there was a relationship between the clinical placement and students' learning and the hypothesis was formulated in the belief that a relationship exists between two variables, the independent and the dependent. In this study the independent variable is identified as the effect of the practice setting in promoting the learning of bioscience and the dependant variable is the students' learning style. This conclusion is based on deductive reasoning that if the students' data is correct specific changes can be expected to be found through a further collecting of data that looks for variation in the students' learning style over time.

6.6. Cohort population

The students who contributed to this part of the study were enrolled on the Diploma in Nursing (HEd) at Middlesesx University. They were at the same training establishment as the 94 students in the primary part of the study and undertaking the same professional training programme. They rotated around the same clinical placements as their predecessors for the similar periods of time. None of the students in the second part of the study had been involved in the first data collections.

The study design was implemented in the foundation year of a nursing diploma programme. This part of the data collection took place two years after the initial data collection and extended over a period of one year. Bioscience learning was the subject to be researched and the content and teaching strategies used were representative of first year science in the current diploma of nursing programmes throughout the UK

6.6.1. Cohort sample

Groups of approximately twenty five students formed seminar groups from within the study population (n = 290). The seminar group that was allocated to the researcher became the sample population and was followed through the entire first year of the programme. This group was made up of male and female students in the ratio of 1 : 3 and matched the study population. The mean age of the group was 30 years with the range extending from 18 to 45 years.
The allocation of students into seminar groups was completed prior to student registration at the beginning of the academic year by the admissions office and

independent of the researcher. It was not expected that there had been any systematic bias in the allocation. Despite this limitation it is felt that this exploratory study would still be capable of providing evidence or otherwise of the change to the learning styles of the students.

6.7 Learning styles questionnaire (LSQ)

The Honey and Mumford learning styles questionnaire with minor adaptations was the instrument used to assess the changes to the students' learning style. It was chosen for two reasons. Firstly because this University introduces the concept of a learning style to its students in the key skills module that is studied concurrently with the bioscience module in semester one of year one. The tool would have been used by the students on at least one occasion other than this one thus they would have known the layout, the type of questions and how to indicate their answer options but not have been so familiar with the questionnaire that they would have been able to memorise questions and answers. In addition the questionnaire, an instrument developed by Honey and Munford (1986), had been documented as having been used on student nurses successfully in other research studies (Dux 1989, Cavanagh *et al* 1994). The second reason for the use of this tool was that the tool was devised by Honey and Mumford for use in the work place to enable the individual to adopt an effective learning style within an organisational environment. Such an environment is influenced by the organisation's priorities and objectives and by the climate of the organisation that includes many individuals, colleagues and leaders. Honey and Mumford made reference to the additional factor of consequences that relate to the outcomes of individuals and a company's behaviour. They argued that all these factors would influence a student's learning.

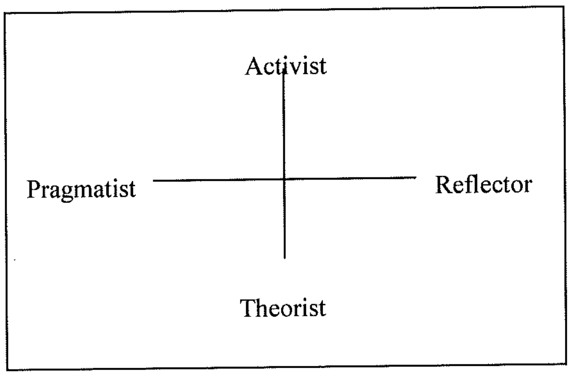
The clinical practice settings for student nurses are the acute clinical wards, theatres, paediatric, obstetric, psychiatric and accident and emergency departments of general hospitals and health centres in the community. These settings are run and serviced by teams of health care professionals working directly with patient and their relatives. These setting are within the jurisdiction of National Health Service (NHS) trusts in Area Health Authorities. Such environments provide powerful experiences for student in a normal working setting on a day to day basis and would be most likely to have an significant impact on student learning. Since this learning style tool was designed and tested for the learning in the working environment it seemed the most appropriate of all the learning styles measures to use to ascertain the learning styles and any changes to that style that took place over time within a group of student nurses for the subject of bioscience.

Honey and Mumford charecterise an individual's learning as being predominantly one of four styles:

- Activists – learners who are open minded to new ideas and ventures.
- Reflectors – learners who are careful and cautious in their approach to new ideas.
- Theorists – learners who adopt a rational and logical approach to problems or new situations.
- Pragmatists – learners who practical and realistic in their thinking and less interested in theory or basic principles.

The learning styles questionnaire diagrammatically arranges each style at right angles to each other and is represented thus:

Figure 8: Dimensions of the Honey and Mumford learning styles questionnaire



Adopted from Cavanagh *et al* (1994) p38

6.7.1 Advantages and disadvantages of the learning style questionnaire

The questionnaire had several advantages for both the students and the researcher. The first of these was in the use of closed questions.
The questionnaire consisted of eighty questions requiring only a √ or an X in the relevant box. The questions were short and easy to understand and this minimsed distortion of the data due to differing interpretations of the questions on the part of the students. Because there were so many questions and because the questionnaire was only administered at six monthly intervals it also had the advantage of being difficult to memorise so the students were compelled to consider the question as new on each occasion. This reduced the possibility of bias due to repetition on the students' part. The use of questions presented in such a consistent manner also reduced the possibility of bias for both the student and the researcher (Burns and Grove 1997).

Closed questions made tabulating the responses to each question easy for the researcher and allowed for a clear comparison with the categories system provided by Honey and Mumford and hence analysis of the questionnaire. The closed nature of the questions permitted intense focus on the students' perceptions of their learning of bioscience and since this was the aim of the measurement closed questions seemed appropriate. Another advantage of the questionnaire was that it had been developed specifically to assess learning styles and had been tested on other occasions. Burns and Grove (1997) supported the repeated use of questionnaires form previous studies. They argued this facilitates comparing the results between studies especially if the questionnaires are used and analysed in exactly the same form as in other studies.

One disadvantages of the questionnaire was identified by Cormack (2004). He warned against the exclusive use of closed questions to collect data as he claimed this type of questioning tended to address research superficially. However the intention of this part of the study was to supplement what had already been discovered about learning styles and the tool used had to be designed to focus very narrowly on the facts that would indicate a change to the students' learning style. In contrast open- ended questions are much more difficult to interpret and when large samples of data are acquired content analysis may fail to extract the consistent meaning hence closed questions were the most useful. The number of questions asked of the students can also be disadvantageous as individuals may feel disinclined to repeat the event. The students and the researcher in this study were committed to their programme of learning and teaching and wished to contribute to anything that would improve their learning and teaching or that of future students. There was no intention of refusing or evading occasions set aside for the provision of data. Here the use of closed questions made the asking of many questions acceptable.

The led to another difficulty with the questionnaire in that it generated much information on each occasion. Polit and Beck (2004) claim this is necessary as a variable may take some time to manifest itself clearly. This meant that it was necessary to analyze the data using the relevant score system very soon after the collection and to store the data carefully. This involved the making of notes giving clear and precise instructions and careful but simple tabulation of the data to allow ease of understanding later when the action was repeated.

6.7.1 Validity and reliability of findings

One of the greatest risks in developing questionnaires is in leaving out an important response (Burns and Grove 1997). Such omissions make the make a questionnaire invalid and therefore unreliable. Honey and Mumford attempted to establish the reliability of the questionnaire by using a sample of fifty individuals and traditional test/retest techniques within a two week interval between administrations. Statistical support was provided for positive claims following the use of the Pearson correlation test that gave a reliability of 0.89 for the questionnaire.

Claims that the instrument has predictive validity were confirmed following the repeated administration of the test which attempted to predict the behaviour of various groups of students as to whether they would participate in discussive learning approaches as opposed to preferring to stick to tried and tested methods (Honey and Mumford 1986). Statistical support was provided for their claims.

Despite the above claims it is difficult to feel completely certain about the validity of this instrument as there were so few questionnaires attempting to measure learning styles available with which to make comparison. Added to this is the uncertainty that even fewer of these studies have been carried out on Diploma of Nursing students (Cavanagh *et al* 1994, Snelgrove and Slater 2003. They claim that nursing students are different from other university students in that they are older and come with different entry requirements and this is likely to have an impact on their learning styles. Any LSQ should also consider other influences such as these on learning style. Nevertheless studies have indicated some success in determining the learning styles of nurses using this tool (Dux 1989, Sutcliffe 1993, Cavanagh *et al* 1994)

6.7.2 Time triangulation

Despite the assurances and uncertainties provided by other researchers concerning the validity and reliability of the tool itself, steps to improve the likelihood of obtaining more accurate results from the data provided included the use of triangulation over time. This involved collecting data concerning the learning styles from the students involved at different points in time in order to demonstrate congruence with respect to alteration in their learning styles. This would bring different images of understanding, potency and certainty to the findings (Smith and Kline1986, Matheson 1988, Shih 1998)

6.7.3 Procedure

All data were collected prior to the commencement of periods of clinical practice on three separate occasions throughout the first year. They were at the:

- beginning of semester 1
- beginning of semester 2
- beginning of semester 3

During the first two weeks of commencing the semester each student was provided with the 80 point questionnaire in a normal classroom session and given 30 minutes to complete it. This procedure was repeated in the first two weeks of semester 2 and 3. Students awarded each question an √ or X depending on whether they answered yes or no to each question.

6.7.4 Analysis of data

The individual students' score for each learning style was counted using the grid provided with the LSQ. and the learning style of each student nurse was identified. The predominant learning style was identified as the style achieving the highest mark. Where two or more styles were of equal score a hybrid learning style was named.

The learning style of the whole group was also determined by counting the scores of each student for each category of learning style and then averaging the respective tallies of all the students using the mean. The score obtained for each style was rounded up to the nearest whole figure and plotted on the axis and a determination made of the profile of the learning style of the group.

6.8 Limitations of the study

Despite attempts to obtain as truthful a set of data as possible the following limitations have to be considered.

Prospective longitudinal studies examine patterns of change over time and time becomes an important factor for it creates several difficulties for the researcher and the student. For the researcher this requires a considerable amount of administration to group and classify the data and to make certain that the analytical processes used are fully written down so that the same procedures can be repeated on analyses of subsequent data. Meticulous care on the part of the researcher was needed and adhered to in order to prevent any such inaccuracies from polluting the data and although there was an awareness of this it is still possible that some distortion could exist. Both Polit and Hungler (1999) and Bowling (2000) warn of such possibilities. There has to be considerable commitment on the part of the researcher and the student over an extended period of time to the accumulation of data. However they still credit prospective studies with having considerable strength in their findings and suggest that many small ambiguities can be resolved with repeated data collections something that this study included in its initial design in order to try and minimise such errors.

Another difficulty that Cohen and Manion (1988) point out is that the data may be influenced by attrition caused when students leave the programme before all the data has been collected. As a consequence the cohort becomes smaller and it becomes questionable as to whether it is truly representative of the population being studied. Watkins and Hattie (1985) referred to these students as the 'most disillusioned' and there was the implication that a negative outlook for the course and their learning made have affected the responses made by these students on the questionnaire. On the other hand Zeegers (2001) expressed concerns about the *all trial* students, those who stayed the full length of the study for he claimed that their level of motivation to succeed on the programme may have influenced their responses in an unusually positive way.

It is difficult to avoid the loss of group members and it was noted that the current study lost six students between the first and second data collection because two students left the programme and three failed to attend on the day the questionnaire was administered. By the third data collection one more student had left the programme although all the remaining students attended and provided the final data collection. Cohen and Manion (1988) advocate caution with respect to any 'topping up' of the group with additional members as this could further dilute findings. However this was not an option available to the researcher in this study. Student intakes occur at set intervals in an academic year and adding more students to a seminar part way through the programme was not available.

Bowling (2000) made reference to a possible *hawthorn effect* that she identified as a tendency on the part of the researched to behave in a different way from usual because they were part of a special study. One of the ways that this may be demonstrated by the students was by them recalling what they have answered to some of their questions from last time and repeating it again on the subsequent questionnaires. In this way they could change the data. In order to lesson any opportunity of this happening the frequency of the questionnaire administration was keep to six monthly. This would have hindered the ability of the students to recall what they answered but still provided the data required.

In order to reduce the effects of all of the above difficulties it might have been best to either study a much larger cohort of students or carry on with the longitudinal trail for a longer period of time. Neither of these options was available to the researcher at the time and it is suggested that the results obtained in this study be viewed with some caution.

The final limitation related to the use of triangulation over time. There was only a period of one year available to collect the data before the students' moved on to the branch part of the programme and the foundation bioscience of the curriculum was considered to be complete. Three samples of data could be obtained in that time after each practice placement but no more. It was possible that this may be inadequate to confirm the hypothesis or might even produce batches of data that were contradictory. This would make it difficult to support any claim that the learning style of the student that was positive for bioscience was changed by influences within the practice setting and was best developed within the clinical setting.

6.9 Ethical considerations

The students were told of the reasons for the study and invited to participate or otherwise without consequence (Appendix 2). They all expressed their willingness to participate. Confidentiality was assured.

Summary

Bioscience is considered a difficult subject to learn and in order to be successful in their programme of training the learning style that a student adopts must assist their learning. Assuming that the earlier findings that suggested the learning of bioscience that was informing for practice was best achieved within the clinical context were correct, assessment of learning style was carried out on three separate occasions using the Honey and Mumford LSQ with minor adaptions in an attempt to detect a change to the students' learning styles as they progressed through the first year of their programme. A student group of approximately 25 students were involved over a period of one academic year. The limitations of the study were discussed.

CHAPTER 7

RESULTS OF INVESTIGATION OF THE LEARNING STYLE

7.0 Introduction

The findings presented in this chapter are the outcomes of using an adaptation of the Honey and Mumford Learning style questionnaire on the same group of students on three different occasions over a time span of one year in order to observe for any changes to their learning style. The use of multiple data collections permits a phenomena to be observed during a developmental stage and helps to strengthen the reliability and validity of the initial findings by providing time triangulation.

7.1 Data from the learning styles questionnaire

7.1.1 Beginning of semester 1

Twenty one students from the group of twenty five provided the findings for this set of results. All of them completed the Honey and Mumford LSQ in the time allocated and with specific reference to bioscience. The findings on this occasion were as follows.

The number of points attributed to each learning style by each student was counted and the dominant style for each group member in the group was established as:

Beginning of semester 1

Table 9: Number of students identified for each learning style (N=21)

Pragmatist	Activist	Reflector	Theorist	Hybrid
0	3	0	8	10

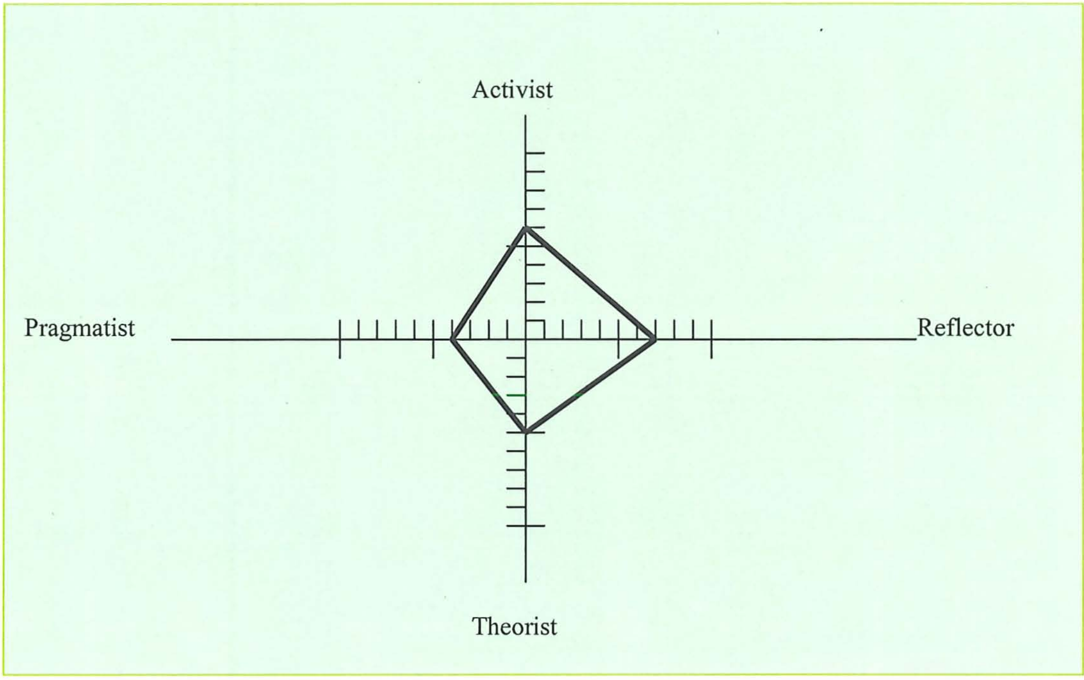
Counting the scores given by the students to each recognised learning style the results were as follows:

Table 10: Scores of the individuals within the group for each learning style. (N=21)

	Pragmatist	Activist	Reflector	Theorist
Individual score totals	78/21	122/21	131/21	102/21
Mean	4	6	7	5

The mean scores of the group for each learning style were used to create the following group profile.

Figure 9: Learning styles questionnaire group profile-beginning of semester 1



Of the four possible learning styles described by Honey and Munford only two dominated within the group. They were Activist and Theorist and of these the theorist style was claimed to be practiced by the greater number of students. A style not identified within the learning styles descriptors but found within the students of the study was that of a hybrid style. A hybrid learning style was said to exist of the student grossed an equal number of points for two or more learning styles. 10 out of 21 students (47%) claimed to subscribe to a hybrid learning style. This style is not represented on the group profile as it has no legitimate place within the diagram devised by Honey and Mumford. The students who were identified as belonging to this style were therefore excluded from making a contribution to the overall group profile and the presence of this learning style remained hidden.

7.1.2 Beginning of semester 2

Fifteen students from the seminar group of twenty-five provided the findings for this set of data. They used the Honey and Mumford LSQ again and focused on the learning of bioscience. The findings were as follows.

Table 11: Number of students identified for each learning style (N=15)

Pragmatist	Activist	Reflector	Theorist	Hybrid
0	0	0	6	9

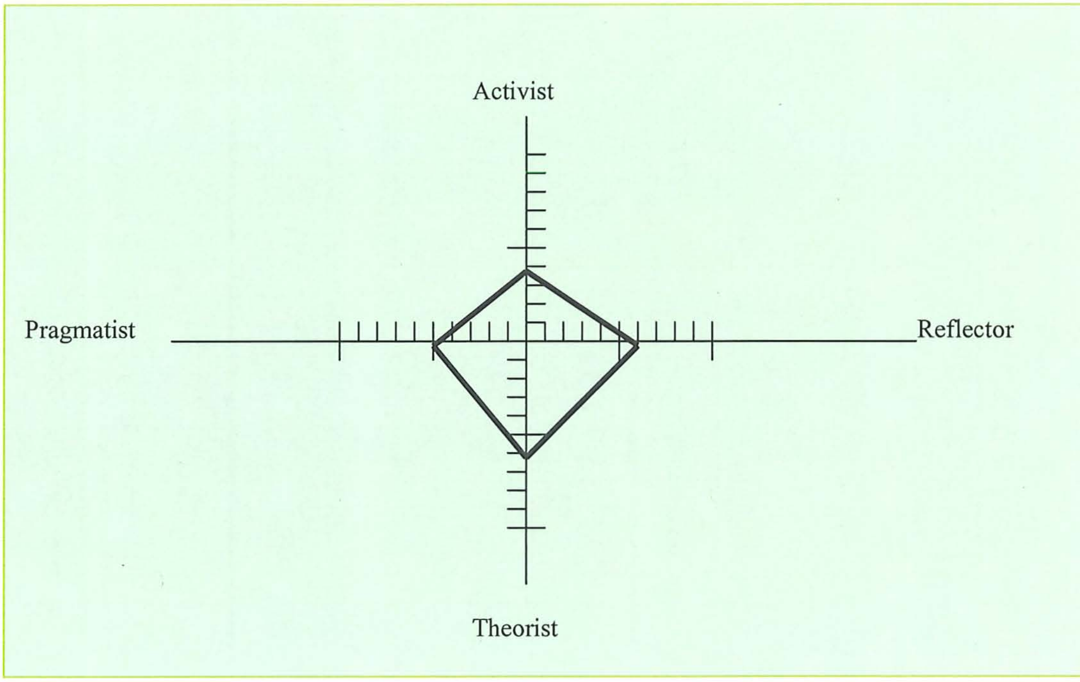
The mean scores of the second data collection for the recognised learning styles showed a variation of only one point between the styles of pragmatist, theorist and reflector with the activist group showing a decrease of two points when compared with the first set of data.

Table 12: Scores of the group learning styles showing dominant styles (N=15)

	Pragmatist	Activist	Reflector	Theorist
Individual score totals	76/15	60/15	85/15	88/15
Mean	5	4	6	6

Using the information provided by the mean the following group profile was constructed.

Figure 10: Learning styles questionnaire group profile-beginning of semester 2



The data from the second collection relating to the individual students' learning style identified one dominant learning style from within the group, that of theorist. This style was identified in the semester 1 students' data but here there was a decrease of two in the total number of students claiming to follow this style. The number of students who originally claimed to use an activist learning style had disappeared whilst the number of students who claimed to have a mixed learning style has risen to 10 out of 15 (66%), a rise of 29% from the first data figures. Again the findings concerning the hybrid style are not expressed on the group profile.

7.1.3 Beginning of semester 3

Eighteen students from the original group of twenty-five provided the results for this set of findings. The Honey and Mumford LSQ was answered by all the students in the set time span. The students focused on their learning of the subject of bioscience. The findings were as follows.

Table 13: Number of students identified for each learning style (N=18).

Pragmatist	Activist	Reflector	Theorist	Hybrid
0	0	0	7	11

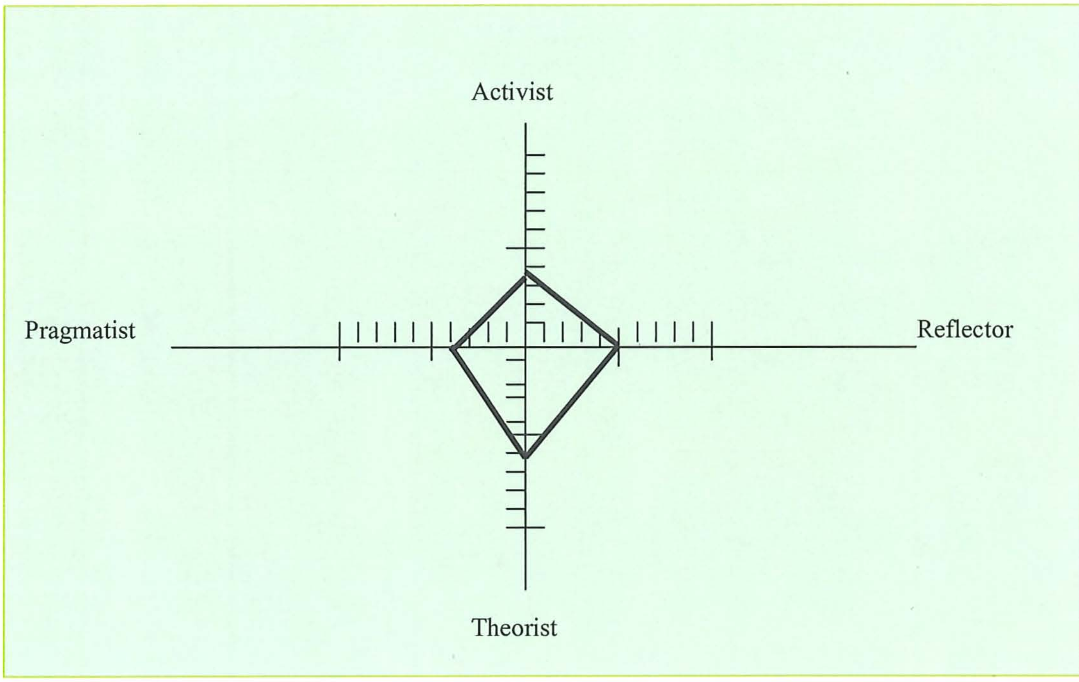
The mean scores for the recognised learning styles showed a variation of only one point between the styles of pragmatist and reflector styles while those of activist and the theorist groups remaining unchanged.

Table 14: Mean scores of group learning style showing dominant group (N=18).

	Pragmatist	Activist	Reflector	Theorist
Individual score totals	78/18	62/18	89/18	115/18
Mean	4	4	5	6

Using the information provided by the mean the following group profile was constructed.

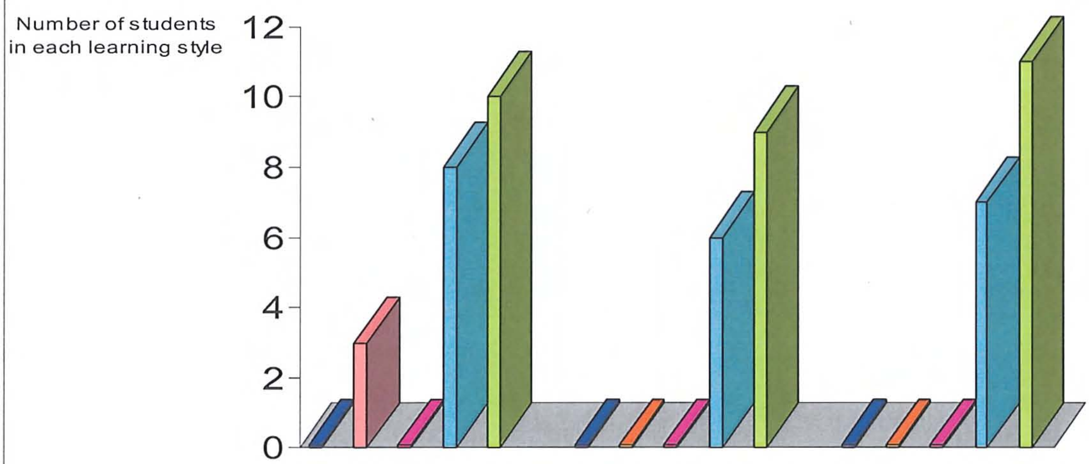
Figure 11: Learning styles questionnaire group profile –beginning of semester 3



The third set of data showed only one dominant learning style that of theorist. This presence of this style is in keeping with the findings of the two previous data collections. The total number of students for this group has declined by two in comparison to the first set of data but increased by one compared with the second set of data. The number of students claiming to use a hybrid learning style is 11 out of 18 (61%). The percentage for this data is down 5% in comparison with the second data collection but is increased by 14% in comparison with the first data figures. This effect of this group on the group profile is again unaccounted for as in the first two sets of data and continues to remain hidden.

On comparing the numbers of students who were identified as belonging to all learning styles from within all three data collections the following picture emerges.

Figure12: Comparison of student learning styles as identified using the Honey and Munford learning style questionnaire over a period of one calendar year



Beginning of: semester 1 semester 2 semester 3

(4 months) (8 months) (12 months)

Activist Pragmatist Reflector Theorist Hybrid

Key to learning style:

Summary

Data was collected from the cohort on three separate occasions within a one year period using the adapted Honey and Mumford LSQ. Analysis and comparison of the learning style used by the students pointed to the adoption of the hybrid style by more and more of the students as time passed.

CHAPTER 8

DISCUSSION OF THE FINDINGS INTO THE INVESTIGATIONS OF LEARNING STYLE

8.0 Introduction

The investigations into the learning style preference of the Diploma of Nursing students originated from data collected in the first part of this study. The indications were that students best learned bioscience in the clinical setting along with other members of the clinical team and in the presence of the *real* patient. Reflections on the meaning of these findings led to the hypothesis that in order to utilise these conditions and achieve learning so that it was informing for their practice students would have made a substantial change to the way that they learned this subject. If this was what had happened it should be possible to detect that change as it emerged and developed using a recognized learning style questionnaire as a tool. The aim of this stage of the study was therefore to monitor the learning style preference of a group of students using Honey and Mumford's learning style questionnaire over a period of one calendar year and observe for any changes.

The findings from the learning style questionnaires administered to this population of student nurses over the stated time indicated that they did change their learning style for the subject of bioscience as they progressed through the programme. As a result the alternative hypothesis was accepted.

However, it was also noted that at the end of the first year, although the students did not show a preference for any one of the learning styles identified with Honey and Mumford questionnaire they seemed to have developed a fifth style -a hybrid, that was adopted by more and more students as they progressed through their foundation year. Students had been asked to consider their learning only in relation to bioscience when answering the questionnaire but there is the possibility that the learning style that they adopted when in clinical practice was the same for all practice learning and not just bioscience. It was the practice setting that changed their learning style but because this change had not been investigated before it would not have been identified. The intention for the remainder of this chapter is to consider learning styles and how they influence learning for the health care professional, to explore the changes that were seen in the data collected concerning the students' learning style and to recommend a way forward for the teaching and learning of bioscience.

8.1 Learning styles

Learning styles are defined as distinctive behaviours which are focused on learning (Smith 1984, Entwhistle 1988, Brink 1988, Lapeyre 1992). Other factors influence learning in either a positive or negative manner and have been identified by (Kolb (1984), Pask 1976, Wilkin *et al* 1977, Ramsden 1979, Laurillard 1979, Cranfield quoted in Merritt 1983, Blagg 1985). Kolb (1984) made particular reference to the impact of experience on learning while Ramsden(1979) and Laurillard (1979) saw the dynamics of the situation in which the learning was taking place as being of great influence. Alexander (1983) and Gott (1984) identified practice situations as an important aspect of professional training.

The necessity to learn in a different way was clearly identified from the findings in the first part of this research. Practice situations contain experience and experience corrects the professional practices defined by text books because they are made up of complex and novel situations and an uncertainty and variation that defies book theory (Greenwood 2000, Maudsley and Strivens 2000). In 1987 Schon highlighted this dilemma and referred to it pleuralism in professionals and called for a move away from focusing on the theory and concept analysis towards practice in a professional setting which required a reframing of situations until they could be understood. Schon is supported by the work of Eraut (1995) who talks of deliberate analysis and process knowledge. The implication from such readings is that the knowledge of bioscience that the students require to learn for practice should be derived from real situations that have been seen on many occasions and from many perspectives. This means that learning to use a subject can only take place through considering situations in context along side other persons who are experienced at dealing with similar situations.

8.1.1. The Hybrid learning style

An individual's learning style is defined within the literature as a collection of approaches that are employed when that person sets about learning. Honey and Mumford (1986) indicated that there were four major styles that the student could adopt to bring about learning and these were based on the set of approaches that the learner adopted to bring about learning for themselves as identified by their questionnaire. These sets of approaches charecterised learners as being open minded to new ideas or careful and cautious or adopting a logical approach to situations or being practical and realistic in their thinking and were named as Activist, Reflector, Theorist and Pragmatist learning styles respectively. One of the major styles employed by the students at the beginning of semester one in this study was that of theorist. Honey and Mumford claimed that theorists learned best and least from the following activities.

Table 15:Theorist learning preferences and dislikes

Activities that assist learning

- That what is being offered is part of a concept, theory model
- That there is time to explore the inter-relationships, events
- The chance to question assumptions
- That situations are structured and with a clear purpose
- That they can listen/read about ideas and concepts that emphasis logic and reason
- Analysis and generalise the reason for success or failure
- The opportunity to consider interesting ideas and concepts even if they are not of immediate relevance
- Understand and participate in complex situations

Activities that hinder learning

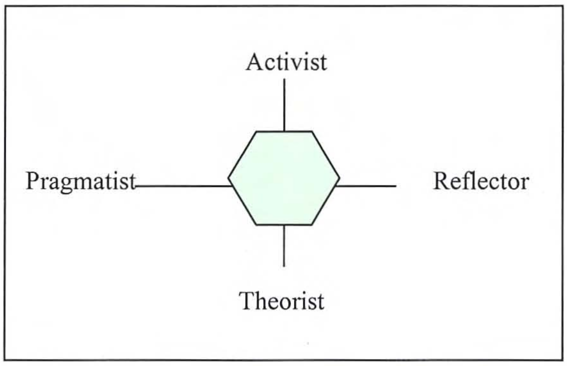
- Precipitation into a situation that lacked purpose and context
- Participation in situations that were emotional and emphasised feelings
- Unusual situations were ambiguity and uncertainty were high
- Asked to decide without an understanding of a concept or principle
- When faced with a collection of contradictory or alternative techniques that were not fully understood
- Where there was doubt that the subject matter was methodologically sound
- Where the subject matter was shallow or gimmicky
- Where the student feels out of harmony with the others in the group

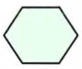
Adapted from Honey and Mumford (1986)

On comparing both tables it became apparent that clinical practice contained all the factors that theorists did not find to be supportive of their learning. Eraut in (1995) described clinical practice as *unpredictable* and *uncertain* and referred to the many times when there was ambiguity as to what to do. Sometimes participants could find themselves in situations that they did not fully understand and where the actions of the most experienced person were given greater attention than the proof of the research based findings that they had been taught about. Feelings and heightened emotions had already been highlighted in the first set of findings in this study by the students as having an effect on their learning. Schon as far back as (1987) likened professional practice to a *swampy lowland* and claimed that clinical practice was filled with dilemmas and conflicting situations. In truth the impression was that all the students deeply embedded theorist strategies for learning were now proving to be unhelpful.

Initially the findings from this study showed the students least favoured the reflector and the pragmatic styles leaving the activist and theorist styles to dominate. Examination of the students' learning style for bioscience at the end of one academic year, saw changes in which three or all four of the learning styles of Honey and Mumford were identified as making an equal contribution to the final learning style of the student. It was as though they had created a new learning style that served them best in learning this subject. This fifth style named, the Hybrid style can be diagrammatically represented as:

Figure 13: Dimensions of the Honey and Mumford learning styles with modification



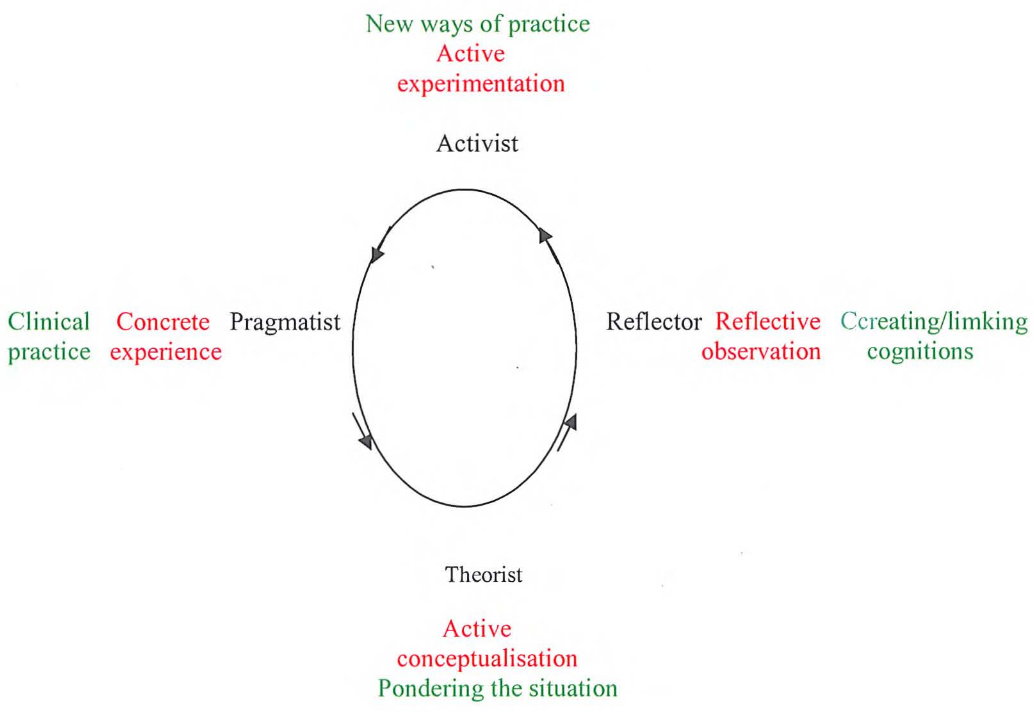

= Hybrid style

Adopted from Cavanagh *et al* (1994) p38

Honey and Mumford based their learning style development on Kolb's theory. Kolb saw learning as a series of experiences with cognitive additions rather than the pure cognitive processes. Learning was a circular process in which experience was followed by reflection and observation and this in turn led to concept formation and generalisations that were tested in experimentation. Kolb thought all the stages had to be worked through for learning to take place and he identified a circular learning pattern. If these ideas are linked to the Honey and Mumford analysis used in this study the following explanation suggests itself.

The students in this study began to change their style of learning bioscience when they encountered the situation in the clinical context. This encounter related to pragmatism in which practice and realism dominate. Consideration of the situation introduced the reflector in the student as discussion and exposition of the situation were carried out by the clinical group. The student had to ponder the adequacy of explanations rather than trying to devise how to deal with the situation hence bringing the theorist aspect of learning into play. Here the student would seek to achieve an understanding of what was being discussed using his own cognitions of bioscience. The activist means the student would try different ways of dealing with the situation and would look to others to help him find more ways. Arranging these possibilities together produced the following diagram.

Figure 14: Diagrammatic representation of Honey and Mumford learning styles, Kolb's experiential learning cycle and the students in the clinical context



Kolb argues that this approach to learning constitutes a problem solving style. In support of this idea is the work of Brandsford and Style (1996). Their work was informed by the work of Wallas (1926) into problem solving. They suggested the following stages using the steps of (IDEAL).

Table 16: Bransford and Stein's framework for problem based learning

Identify the problem
Define the problem
Explore possible strategies
Act on the strategies
Look back and evaluate these actions

Adapted from Maudsley and Strivens (2000)

This is further modified by Snowman and Biehler (2000) to give the following:

Table 17: The problem based learning cycle

• Realise that the problem exists • Understand the nature of the problem • Compile relevant information • Formulate and carry out a solution • Evaluate the solution

Adapted from Snowman and Biehler (2000)

Clinical practice provided learning actions that involved thinking by providing support, encouragement, opportunities and guided practice involving principles and techniques. Coles and Robinson (1989) argued that such activities led to the development of critical thinking and this in turn leads to the ability to problem solve. De Bono (1978) supported this idea for he believed that thinking skills never developed as a by product of subject learning but as the result of appropriate instruction, in this instance, the situational considerations by the students. Characteristics which emphasise problem-solving development include brainstorming and group discussion. Group discussion develops problem solving by concentrating on the process and not on results and by challenging schemata and attitudes (Abercrombie 1960). A useful way of dealing with professional knowledge was suggested by Barrows (1986) who aimed to promote knowledge structuring in clinical contexts, clinical reasoning, self-directed learning skills and intrinsic motivation through problem based learning (PBL). But according to Brookfield(1987) it is the peer support of group work that develops the skills of concept development, problem-solving and critical thinking and not just the problem solving activities. Students in this study claimed it was being taught within the practice setting that promoted valuable and realistic learning as it permitted group support, discussion and problem solving to take place concurrently.

Nursing education has been aware for some time that students move between two learning environments, the classroom and the practice setting. The existence of two sets of theories, the theory of the classroom and the theory of the practice setting, maintains a theory-practice gap that might be reduced if theory is learned and taught in context accompanied by the opportunity for reflection. The classroom description of the patients' altered bioscience is never the same as that encountered in the practice setting. Classroom perspectives tend to generalise while students need the specific details of the practice experience to create the links that allow them to see and understand variations of bioscience. This involves an element of reflection. Reflection is not seen as fundamental to the learning of bioscience but as a teaching tool it offers considerable benefits to understanding patient care needs in relation to bioscientific changes. It also provides a way of revisiting a topic and influences the transfer and retention of information for practice. There are specific details and a clear limit to the disordered bioscience the patient is presenting with in reality, something that hypothetical situations often used in the classroom do not have and which the student cannot ask questions about for there is neither patient nor colleague to ask. Students stated in this study that they did not transfer their learning from the academic setting to the practice setting they simply learned the theory again within the practice setting and it was this knowledge that they transferred form one clinical situation to another. The findings of this study point to the ineffectiveness of traditional methods of education for the subject of bioscience mainly because they detract from the advantages of the clinical setting for relevant learning where the onus for learning is with the student rather than the teacher.

8.2 Problem based learning (PBL)

The progressive change seen in this study to the students' learning style seemed to indicate that the contextual setting may be prompting the development of problem based learning in the student. In the last decade particularly medicine and more slowly nursing programmes have moved towards a new type of curriculum based on problem solving. Reviews of the effect of these programmes are now beginning to emerge and none of them is complementary to problem solving learning. Colliver (2000) reports that it has made an obvious impact on student learning in medicine but there is no evidence of benefit while Biley (1999) reporting on the effects of PBL over four years in a nursing programme acknowledged that it was a constant source of frustration uncertainty and and dissatisfaction. She conceded that there were advantages and disadvantages but these were submerged by dissatisfactions. However studies such as Biley appear to have concentrated on attempts at pursuing problem solving strategies in non contextual exercises. The findings of this study indicated that it is the context that pushes the learning not the activity of using the problem based cycle in a hypothetical situation. Strong motivational factors exist in context to hasten learning along with the opportunity to revisit a situation.

Kempa and Hodgson (1976) claim that this is reinforcement and is a prerequisite to concept formation and future problem solving but Kempa and Hodgson also rate such events as difficult for students because they have to use scientific language at a high level where the understanding of the subject at a conceptual level has not yet been acquired. Students require many exposures to examples of the concept before they understand it and their grasp of the concept will be retarded initially at least by a lack of language skills. Attempting to communicate in two languages results initially, in a narrow systematic style of learning that is characterised by memorisation and rote learning (Kemper and Gow 1990, Kember 1996) but memorisation and rote learning do not assist the student to understand the dynamic scenario of practice. The effect of such exposures to contextual situations must have caused these students to refocus their attention sharply upon the subject of bioscience and this in turn would have allowed ways that promoted the learning of bioscience to begin to develop.

Reflecting on the work of Kempa and Hodgson (1976) into the development of scientific conceptualisation leads to the belief that the ability to understand a concept only comes after repeated exposure to exemplars that are accompanied by instruction. It could be argued that the study of science subjects at school tends to involve considerably more intellectual development on the part of the student since laboratory work usually accompanies all scientific work and this demands application of knowledge to specific situations and problem solving.

However students of nursing are not obliged to have any previous qualifications in science and so the development of intellectual skills provoked by scientific learning is not present in the majority of current nursing recruits. Despite this handicap the students in this study claimed that the use of the many exemplars in the form of patients from the practice setting whom they recognised as problematical to them allowed them to learn bioscience so that it supported clinical practice.

In practice the student is more often introduced to learning at the level of a concept. For example the student may see the patient as an alcoholic initially rather than as someone having disordered bioscience of liver failure. It takes the concept to be broken down into specific bioscience changes before the student begins to see the jaundice, the itchiness of the body skin, the distension of the abdomen and the dark coloured urine to realise that these separate observations are all part of the pattern that together form the concept of liver failure. This breaking down process involves a series of steps identified by Patel *et al* (1991) and Norman and Schmidt (2000) as the part of the process of deductive reasoning. Here the student is brought from the first vision of the whole concept of a disordered bioscience to its component parts which the patient will mostly identify to the student as being his/her problems and which the student will see detailed on care plans and history sheets. It would appear that backward reasoning allows the student to see bioscience from an entirely different perspective and it is this examination of the clinical reality of the subject that seems to push the student to adopt new strategies for learning that altogether result in the formation of a new learning style as was identified in these students at the end of their foundation year.

Although the students in this study did not provide evidence of being capable of problem identification in the clinical setting as depicted by Maudsley and Strivens (2000) and Snowman and Biehler (2000),all the other stages of the problem solving process depicted in tables 16 and 17 (p272) were used by them. This failure to see the problem may be a feature of junior students where there is a lack of understanding of science language and concept formation. The presentation of a bioscience problem exposed in the real situation has to be learned and recognised before future problem identification can begin. So the early stages of development of a problem based learning may have to be filled with categorising what was seen and fitting it together as a coherent whole before all stages of a problem solving strategy are utilised. Encounters such as listening to the patient's tale resulted in the recognition by the student of what was and what was not understood. There followed a period of inquiry. Inquiry involved communication with the clinical team, the patient, the patient's family, peers, textbooks and data review from other investigative procedures such as blood analysis, X ray reports, CT scans etc and written commentaries from other members of the healthcare team eg dietician, physiotherapists. The implication is that such inquiry focused activities in students are initiated by the tales of specific patients and culminated in an understanding of this subject that informed practice.

8.3 Using the real Patient

Using patients presents students with constant exposure to real-life bioscience problems. Since patients do not present themselves to a health care professional until they have a disturbance of their bioscience there is a greater emphasis on the ability of student nurses to be able to understand the disordered bioscience as it is the form first encountered. The ability to understand the many patient tales of disordered bioscience would be perfected through repeated practice using a sequence of steps. Repeated practice also permits the acquisition and retention of knowledge and makes retrieving that information easier when it is required in the future.

This is keeping with the comments of Pask (1976) and Eraut (1993) who claimed that students developed stable learning styles over time when repeatedly exposed to situational requirements. Pask expressed some concern for students who exhibited a variable or uncertain learning style and questioned whether they would ever be able to adopt a settled learning style but for the students in this study the theoretical learning style used in the classroom did not assist them in practice and it was imperative that they found a new style for practice. The evidence of this study reveals a change that is progressive and would suggest that in time this style will become a fixed style that is of full relevance to professional practice. Rampogus (1988) suggested that students acquire more specific ways of thinking as they become exposed to more and more learning. This he goes on to add that this is the consequence of encounters in both the educational setting and the clinical placement and he claims that students alter their learning style so that one learning style may dominate for this topic and another one for that topic therefore learning style is not a constant but a dynamic process. It seems reasonable to assume that the data in this study is showing this change in learning style taking place for the subject of bioscience in the student group. Such changes have been detected in nursing students and reported in the studies of Dux (1988). However Dux looked at nursing learning in general and not specifically at bioscience and it is not certain from her data in which direction the students' learning style diverted but she clearly revealed that it was happening. She considered it to be a positive finding as it suggested that the ability to be adaptable would be beneficial to students in the dynamic environment of the practice setting.

Learning in context differs from that of theoretical learning in a non-contextual situation. In context the students learn a holistic set of actions and explanations from experienced practitioners. They learn how to observe, the interpretations to link to observations and what words and actions to use when relating these to their colleagues and patients. The clinical context reinforces the professional identity of the student because it has *real* patients and *real* colleagues and is highly motivational. Students advance through their foundation year and develop into advanced beginners by incrementally acquiring knowledge and skills that are based on experience. Their clinical competence and judgment increases because they acquire a technical command of knowledge and performance in contextual situations that includes bioscience (Benner 1984, Dreyfus and Dreyfus 1984). In support of this Sutcliffe's (1993) study identified that students preferred to learn about disordered bioscience through the medium of a case study. Case studies focused on patients and saw nursing as holistic. Holistic care views the patient within his family unit influenced by social, psychological, environmental and other life pressures. Therefore in practice patients were viewed in a living context presenting with a problem and not as a series of systems or functions as related in the theoretical context. Professionals would therefore adopt the problem based cycles and begin by looking at the problem who would be the patient. This method of dealing with patients would be repeated time and time again throughout the clinical day and all the team members would work their way around the problem based cycle for each patient. Students would be exposed to this method of patient assessment on a daily basis on many occasions and would eventually learn how to carry out this activity for themselves. They would also come to view this strategy as the most appropriate way of learning about patients since they would have validated it for themselves and seen other more skilled and knowledgeable professionals do likewise. This links to the findings of Kolb (1984) who claimed that learning in occupational disciplines produced learning styles that were congruent with the subject and positively promoted learning. So an ineffective learning style in the student would have to change if professional knowledge was to be achieved and there would be great pressure on the student to conform.

Problem solving asked the student to be inquisitive, to keep gathering and sifting data, to analyze and refine this information until it provided an explanation of the patient's story. It demanded reflection on all the new information and integration into a comprehension of the current patient state. This allowed the tentative suggestions of care interventions to be considered for the patient. Problem solving made the students anxious partly because the patient's story would change daily and sometimes even more frequently as he/she progressed along a disordered bioscience continuum. Then students were constantly presented with varying quantities of unknown data which needed interpreting and reinterpreting. The findings of this study indicated that it was this feature within the context that pushed the learning not the activity of using the problem based cycle. Strong motivational factors existed in context that hastened learning and as a secondary effect pushed the development of a problem centered learning approach.

Zeegers (2001) writings reported that the learning styles identified in secondary school students would be used again by them in Higher Education. Nursing students would be most likely to try to use their already established learning strategies to assist them to learn bioscience. Many students to the current Diploma of Nursing programmes are accepted as mature students and enter the programme bringing with them a variety of established learning styles. Most of these would have been developed by years of exposure to predominantly didactic methods of teaching that encouraged surface learning and dualistic thinking. Secondary schools measure achievement for students in terms of GCEs and GCSEs pass grades and the students would have been schooled to achieve success in their examination topics using a mix of recall and comprehension or surface and deep learning as identified by Newble and Entwhistle(1986). Since this style of learning had been successful for them in the past nursing students would most likely have resisted pressure to change for some considerable time and only after realising the value of the elements in the clinical setting would they have become convinced and begun to adopt different strategies for learning. This would explain why the changes seen to the students' learning style in this study only emerged slowly over the first year but it raises the question as to how much longer would it take for the changes to be completed and what can be done to assist the development of the new style within the new student.

8.4 Recommendations for future teaching

8.4.1 Using the Patients' Tale

The findings from this study implied that the clinical practice of the nursing programme exposed the students to a kind of experience based learning. Here it was easier to develop a new way of learning bioscience that involved the development of a Hybrid learning style and PBL strategies than to attempt to link previous theory to practice. Using this new technique which included the patient, other health care professionals and the motivating effects of emotion within the clinical setting, students relearned bioscience that was important for clinical practice beginning with the abnormal first. They compared abnormal presentations with other abnormal presentations until they came to understand the concepts involved. They made no attempt to transfer their academic learning to what they encountered in practice and. because bioscience knowledge acquired in practice was not assessed in formal examinations the extent of their learning for the subject was not seen.

Based on this information the first recommendation for the teaching of bioscience is therefore to begin with The Patients' Tale as it is encountered within the practice setting.

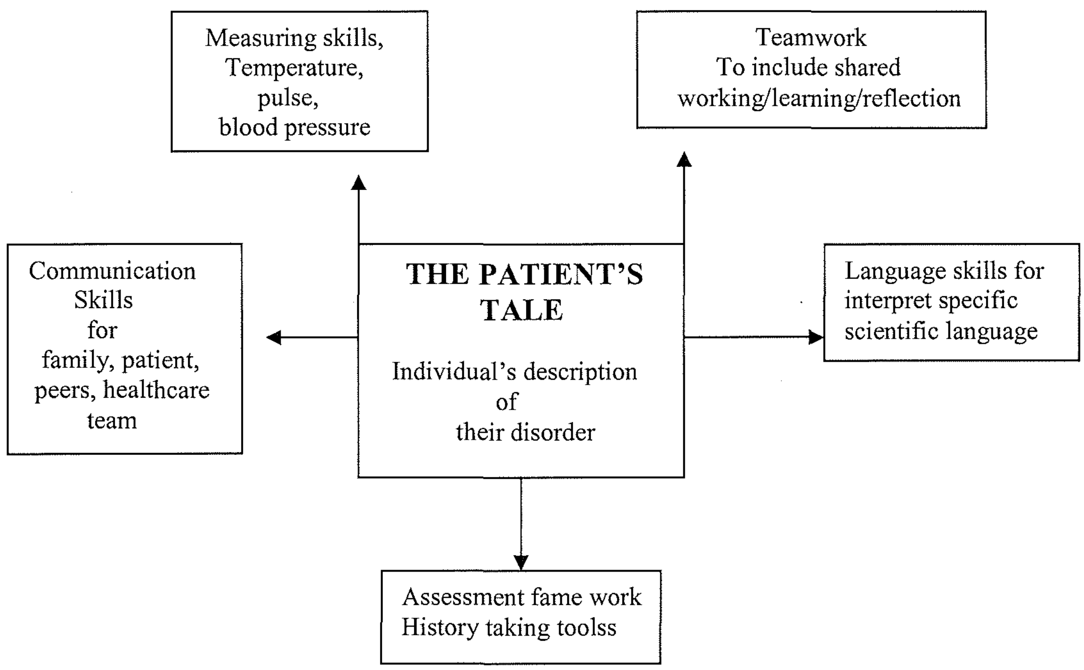
Table 18: Recommendations for teaching the subject of bioscience

- Start in the practice setting
- Begin with the Patient's Tale
- Identify the disordered presentation

The practice setting brings the student into contact with the reality of practice and the other persons in the health care team. Students should be mentored initially and observed to begin with. They should listen to the Patients' Tale as the patient tells it and hear the questioning and the watch the skills of data collection being carried out by the mentor. The opportunity to hear the case discussion should be available and allows the student to hear the many perspectives of decision making care that have to be considered before the final prescription is given. Initially the recitation of the patient's tale leaves the student mystified since this is subject material that they have never been taught yet a subject that they see played out every day in the practice setting. Currently the introduction of disordered function begins in the second year of training when the branch programme begins. This is at a time when students are almost halfway through their course and clinical experience and is too late.

Students should be introduced to patients very early in the first year of training and following an introductory period students should be expected to begin to develop proficiency in the skills of data collection enable them to begin to see and later to recognise patterns of the disturbed bioscience that they encountered daily. In order to participate in this stage of the learning they will have to be introduced to the additional skills of communication, scientific language and history taking frameworks.

Figure 15: Skills utilized for learning bioscience beginning with the Patient's Tale



Patient encounters should be followed by time to make enquires using books, journals, peer group discussions spend time with other professionals and other sources to enable students to get insight and knowledge into the disorders being seen. Students should be expected to present their enquiries for discussion with their peers and mentor frequently and be assessed on what they have presented rather than hypothetical patient cases or text book learning. There should be a slow but continuous handing over of responsibility for patient assessment and bioscience interpretation to the student. Academic programmes have identified levels of intellectual ability that the student is expected to achieve by the end of the programme and student progress could be linked to these. It is possible that progress through the early level of academic learning may be slow at the start of the programme as the student has considerable scientific language impediments to overcome in addition to acquiring a comprehension of disordered bioscience. However this may not be the case and much will depend on the mentor system in place to guide and support the student. In order to assist the student to progress with learning consideration should be given to the strategies that students use to enable them to achieve learning.

8.4.2 Use a problem based learning approach

In seems that the appearance of Hybrid learning style could be the foundation of a problem based learning style. It is closely linked with the theories into what constitutes a problem based learning style and it acquired by repeated practice in the clinical setting and involves elements of the clinical setting to assist its development. The data from this study indicated that this style was developed over time by more and more members of the cohort being studied and this leads to the following recommendations the teaching of bioscience.

Use a problem based cycle such as that proposed by Snowman and Biehler (2000) in which the existence of the problem can be identified by the mentor in the early days of the programme This would allow students to recognise the value of the patient complaints for bioscience learning. The student can then work through the other stages with their peers and mentor and sometimes individually. This will allow backward reasoning to take place taking the student from the seen concept to the individual components of the disordered bioscience. In time when the student has seen many exemplars of the concept it should be possible for them to forward reason by collecting the critical features of the patient's tale and using them to create concepts of a specific disorder. The ability to forward reason allows for problem identification but this would be something that students would not be able to carry out initially as their bioscience knowledge would be inadequate.

Identification of the patients' problems is part of the systematic approach to patient care known as the nursing process. This is in common usage in nursing practice at the present time. This is a four stage cycle which is
made up of 1. assessment 2. planning 3. implementation 4. evaluation. Students are taught to use the nursing process in conjunction with a model of nursing usually Roper at the beginning of their training in the academic setting. However, skilled practitioners often discard the model and prefer to use the systematic cycle beginning with problem identification. In the stage of assessment the nurse

is expected to make a diagnosis of patient problems. Sometimes this is done in two stages, the first enabling a preliminary diagnosis to be made while the second more in-depth assessment will take place later and lead to the prescription of specific goals and will include behaviors that the patient is expected to achieve. It is at the stage of assessment that the student will have the greatest difficulty since there is a deficit in disordered bioscience understanding and this will have to be overcome if the second stage of the nursing process that of goal identification is to be possible. But it at this point that students should begin to learn bioscience that informs practice by considering the abnormal first rather than the normal that never presents initially in practice but which may seen at the end of the treatment process.
Students on realizing what are the problems associated with abnormal bioscience should begin the problem solving process such as that proposed by Snowman and Biehler and begin learning by working through each stage of the process and supported with their mentor and peer group spend time attaining the relevant understanding.

In addition to creating an important learning style for bioscience students will begin to become familiar with the analytical approach to nursing care that is widely used in all the care settings today.

Figure 16: Summary table teaching bioscience using the nursing process framework

Assessment

Using the real patient

in the clinical setting

Problem identification

Disordered bioscience

Student learning of bioscience

The problem based learning cycle

- Realise that the problem exists
- Understand the nature of the problem
- Compile relevant information
- Formulate and carry out a solution
- Evaluate the solution

Goal setting

(Mentor supervision)

Implementation

(Mentor supervision)

Evaluation

(Mentor supervision)

8.5 Critical reflection on the data findings

Reflection of the findings obtained from both sets of data led to the following considerations.

Despite the many changes in nurse education within the last decade the new nurse training courses still tend to teach bioscience material within the confines of the educational institution and therefore separate from the patient in the practice setting. Despite recent reports *Making a difference* (DOH 1999), *Fitness for Practice* (UKCC 1999) and *A Health Service for all Talents: Developing the NHS Workforce* (DOH 2000), in which the importance of the practice setting for students learning is emphasised, there are still a large number of undergraduate health professional courses whose teachers do not use strategies that encourage a reconsideration of what has been seen in practice related to bioscience theory.

Curriculum designers are advised to reconsider the contents of their programme and site disordered bioscience in the subject material to be taught to all student nurses from the beginning of their programme with the responsibility for this subject to be learnt within the practice setting using the *real* patient. With supernumerary status at present in place for the student it should not prove difficult to reorganise the learning programme to incorporate the practice contribution. But it is also clear the early years of the programme must contain other subject material that will support a problem-based learning approach such as communication skills, introduction to assessment tools and the practical skills of blood pressure measurement, pulse taking, urinalysis etc.

At present academic education tends to be dismissive of practical *knowhow* teaching it as part of theory as if it was not worthy on its own. There is an impression that university education is focused on an education system that seeks to measure student learning in terms of the quantity of marks gained and on the amount of time the teacher spends teaching and certainly not on what the student has learned in practice. Schon (1987) claims that this represents a polarisation of learning in which theory is given greater emphasis than practice. This has led to bioscience learning for nurses being undervalued within academia but of immense value in practice. Higher education should be criticised for not emphasising enough professional roles and their differences especially in relation to the impact of context on the learning potential of future healthcare practitioners.

When nursing left the hospital and lost the controlling influence of the service side in the early 1990s to enter the university sector, it was argued that nursing would now be free to teach and the student free to learn. The belief was that some of the difficulties, including those relating to the theory practice gap, would disappear as student learning would now be controlled by the education sector and the focus of learning could be concentrated towards achieving and measuring learning in the settings appropriate to a professional nursing programme. The results of this study indicate that students are still not free to learn what is valuable to them The reality is that they are more often expected to contribute to the practice team's daily work schedule. In the busy world of healthcare and staffing shortages there is no time allocated to the student for undertaking their own learning so the opportunity to come to understand disordered bioscience is neglected and potential opportunities offered by being supernumerary are not taken up. As a result students have to spent additional time relearning bioscience, a subject that many of them have already passed the examinations for in the educational setting but are unable to use in practice.

Bioscience learning in clinical settings is very limited in the present project 2000 nursing curriculum. Most knowledge is transmitted by instruction within educational institutions and hence the clinical learning perspective is weakened. This weakness, as the result of not experiencing the event, means that no meaning can be reflected upon or linked to another experience. Students can only create mental representations of experiences and patients through repeated exposure to them so allowing them to recognise new experiences as similar situations. Concepts and schemata are then learned through deliberate or incidental abstraction form actual instances. The ability to categorise is an integral part of cognition for without categorisation every event would be unrecognisable and knowing what a situation meant and what to do about it would be impossible. For the inexperienced students no matter how much theoretical bioscience they had learnt or how many examinations had been passed the ability to recognise the clinical cues would have been insufficient and they are left with an informational deficit.

The theory practice gap seems to be continuing a have a healthy existence in professional courses. Perhaps this is a feature of higher education who despite their acceptance of professional courses into their university establishments are not concerned to ascertain what it is that makes a professional programme. Instead they try to mould the professional programme into the University construct of what constitutes the academic paradigm. If this is to remain so then it is not likely that the results of this study which clearly highlight the value of learning bioscience in a contextual setting using a problem based approach will be noted.

In addition to concerns about the future use of the findings of this study for bioscience learning, This study has raised another issue that is of great importance to the learning of bioscience and this is that of the role of mentor. At the present time students are mentored by clinical staff but many of them are not able to provide the students with the level of support needed to assist them to learn. Many learners become independent in their learning with time and practice but in the early days when they is a large knowledge deficiency in bioscience and a learning style that requires considerable alteration if it is to support their learning able, the question of the mentor's time, commitment and skill must be examined. The nurse teacher's role since the early 1990s has undergone great change but now seems to have settled to one of liaison with the clinical areas at the present time. Perhaps it is time that this is reviewed if bioscience is to taught in the clinical setting using the patient as the starting point. This is an area for potential future research.

SUMMARY

Students developed a different learning style for the subject of bioscience when they encountered disordered bioscience in the clinical setting. The factors that promoted that change were the real patient, other members of the health care team and emotional factors. The new learning style involved a sequence of steps that are recognized as part of the problem solving cycle. The changes resulted in an amalgam of the four learning styles identified by Honey and Mumford to form a fifth style called a Hybrid style. This led to the recommendation that students should be taught bioscience beginning with the disordered presentation first, using a real patient from within the clinical setting and a problem solving approach.

CONCLUSION

This study set out initially to determine how students on the new Project 2000 type nurse training courses best learnt bioscience that informed their practice and was based on a belief that an understanding of bioscience in practice is essential. The ability to make an informed choice allows for decisions to be made concerning which clinical interventions are the most appropriate for the patient with the intention of advancing rather than hindering a patients' health status.

In the early 1970s questions had started to be asked by health care professionals as to how much bioscience should be taught to students on initial training programmes, how deeply should it be taught and by whom. The subject of bioscience learning and teaching was of special concern. The beginning of the1990s in the UK saw the implementation of Project 2000. This was seen as a new beginning for nurse training and the opportunity to put right some of the difficulties of the past. Evaluation and debate in this last decade concerning the impact this change had on the whole of nurse training has been considerable. Of all the problems identified since that time, there remain concerns around the learning and the teaching of bioscience.

Past studies have suggested that a new teaching method could help to solve the problem and more recent writings have described how new ways of teaching using PBL has been adopted by medicine and occupational therapy. Recent research claims that there are some indications that it is having a positive influence on bioscience learning and this has led other health care professionals, such as physiotherapy to consider that there might be a value in this approach to teaching and learning that would make its inclusion into their initial training programme worthy of serious consideration. This is despite the fact that PBL it is not without difficulties as to how to operationalise but also as to how to assess the learning accrued.

In the midst of all this speculation it seemed that the answer to this difficulty might be to ask the students themselves how they learn this subject so as to make it informing for their practice and to identify those factors that assisted their learning. The information obtained would provide a foundation for the development of a teaching strategy that would support bioscience theory in practice and fulfill the second aim of this study.

The findings of the first part of this study identified three processes that students used to enable them to understand this subject. They were the patient, the clinical context with its team of health professionals and the emotional pressures that the students were exposed to on a daily basis when all three interacted. The students claimed that they relearned this subject beginning with the abnormal science that they met daily in clinical practice and they used the patients' story, discussion with health care team members and reflective practices to promote their learning. They made no attempt to link past studies with the clinical picture presented before them. This study had used action research and qualitative methods to obtain data concerning how students best learnt bioscience for practice. The phase of reflection within the action research cycle on the findings suggested that if students used these processes to develop new strategies for bioscience learning within the context of the clinical setting then it would result in a change to their learning style and these changes would be observable over time. The second stage of the study evolved from the first and sought to identify those changes using the Honey and Munford learning style questionnaire in the hope that this would bring further clarity to the development of a teaching strategy.

The findings suggested that the learning style of the students' did indeed change throughout the first year and they adopted strategies for learning that were similar to PBL. They moved away from their initial style and adopted a style that was a hybrid of some of styles identified within the questionnaire. The implications of these findings led to the following recommendations for teaching bioscience. These have been discussed more fully in the previous chapter but briefly they are:

- Begin teaching bioscience with the disordered presentation first.

- Use the patients' tale and the practice setting
- Use PBL strategies such as discussion, small group learning and reflection.

Using the processes that the students deemed as the most important for their learning of bioscience within the first stage of the cycle of the nursing process allows the teacher to advance the development of a learning style that enables bioscience to be understood and be informing for practice. Introducing such teaching strategies at the start of a programme offers the student the best opportunity to maximise their learning of bioscience so that they came to understand with greater accuracy the patient's presentation and the implications that such an understanding has for care prescribing.

The changes noted to the students' learning style also provoked further thoughts for further research. The learning style of this group of students showed slow and gradual change over a 12 month period. It seemed as though the more clinical practice the student was exposed to the greater the change that was visible in the learning style. But when did that change stop if at all and how great was the change at the end of the programme? The students' learning style would benefit from an extended study that would track its progress throughout the three years of the training and this may reveal further insight and guidance for teaching health professionals.

Limitations of action research

Action research, to my understanding, is about identifying a problem in a specific situation and attempting to solve it in the context by introducing a specific change and then evaluating its effect. Since the context for this study is university education and that involves colleagues, then the solving also means that I must include an element of collaboration with colleagues to implement some change. Although action research allowed me to undertake the first part of the study and the reflection on my findings pointed me towards researching the second part of the study the opportunity to implement any of it or to introduce even a small change the students' learning of bioscience has not yet been possible. My colleagues have been very sympathetic and understanding of my concerns but there is within them an inertia that stops them working with me to do anything about the situation. Some of that inertia has developed because of past failures to influence change in the curriculum as the result of organisational structures. One of most important of those changes involved University education and the beginning of Project 2000. This new training removed the nursing student from their situation within the confines of the hospital and other practice settings and put them instead in the academic context that is without patients and other clinicians and any links to the reality of practice. Teachers can no longer function as clinicians since they have so little time to spend in the clinical context as they are now very often physically distant from the centre of the students' experience. The relationship between theory and practice has been if anything widened and the importance of professional learning within its contextual setting ignored. This situation of separation between the clinical context and the academic setting is common amongst the nurse training establishments and has been since the early 1990s throughout the country. I would suggest that even though this study took place in one large university establishment it is not very different from any others in the UK. It might not be too unkind to say that these changes have disadvantaged the teaching and learning of bioscience for all of them.

Despite my difficulty I am convinced that other researchers will have met impediments to introducing change or who will have found that their attempts to bring about change have been thwarted. Nonetheless I hope that by publishing the results of this study I may hand over attempts to change the situation for the teaching and learning of bioscience to others in a more favourable situation at this time and allow the action research cycle which began here to be completed.

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Appendices

1. Letters of consent to undertake research.
2. Letters to the students requesting participation in research.
3. Semi structured interview guide.
4. Critical Incident framework.
5. Critical incident list.
6. Common themes identified within the CI data.
7. Learning style questionnaire

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NURSE DIRECTOR MISS D WILLIAMS

REPLY TO EXTENSION

3445/4404

Ref: DW/rhf

23 November 1998

Ms C M Kerr
Senior Lecturer
Middlesex University
2nd Floor

Dear Catherine

I have received confirmation from Kate Roberts that Sister Yvonne Carter on Crawshay ward is happy for you to undertake your research as agreed between the two of us.

Charlotte Broughton-Head is happy for you to contact the sisters on Jex Blake and Cordwainers for your research on those wards as well.

Good luck!

Yours sincerely

Di

Di Williams (Miss)
Nurse Director

Middlesex University

School of Health and
Social Sciences,
The Archway Campus,
Furnival Building,
10, Highgate Hill,
LONDON N19 5LW

From: (I)Rena Papadopoulos
To: Catherine Kerr

November 2003

Dear Catherine,

Re: Research into the learning styles of student nurses on the project 2000 programmes

Thank you for sending me your notes on ethical considerations which have adequately answered the ethics committee's queries. On behalf of the committee I am pleased to give your project its final approval. Please note that the committee must be informed if any changes in the protocol need to be made at any stage.

I wish you luck with your research.

Yours sincerely

Rena.

Dr (I)Rena Papadopoulos.
Chair of Ethics Sub-Committee.(Health Studies)

APPENDIX 2

LETTER TO THE STUDENTS

January 1998

Dear Student (Name),

As part of my research at Middlesex University I am conducting a number of interviews with all the nursing students allocated to this ward/community setting for a period of clinical experience during the year 1998-99.

The research focuses on the experiences of students in trying to understand the bioscience that is seen in the placement situation with that which you were taught in college.

The topics to be covered during the interview include

- Does an understanding of bioscience help you in your clinical role.
- How did you work out what was happening.
- Do you believe the bioscience you have learned as a student is enough.
- What have you done personally to increase your understanding of bioscience.

I wish to reassure you that your responses will be treated in the strictest confidence and your name will in no way be linked to your answers. If you feel unhappy about discussing any of the topics mentioned that topic may be omitted. However your answers are important to me and your co-operation would be much appreciated.

Yours sincerely

LETTER TO THE STUDENTS

January 2004

Dear Student (Name),

As part of my research at Middlesex University I am conducting a number of data collections which involve the filling in of questionnaires. Each time you return from your clinical placement at the end of each semester throughout this first year, I will ask you to fill in a questionnaire for me. The questionnaire will ask the same questions each time and ask you to indicate your answer by placing either a cross or a tick in the box shown. You do not have to remember the answers that you indicated on the previous occasion the answers to each repeat questionnaire are considered as new information. The research focuses on the ways that students use to assist them to understand the bioscience that is seen in the placement situation and you are asked to consider only the subject of bioscience when you are reflecting on how you wish to answer.

I wish to reassure you that your responses will be treated in the strictest confidence and your name will in no way be linked to your answers. For this reason I do not want you to write your name or number on the top of the questionnaire.

If you feel unhappy about participating in this study and answering the questionnaire please let me know and you will not have to participate. However your answers are important to me and your co-operation would be much appreciated.

Yours sincerely

APPENDIX 3

SEMI STRUCTURED INTERVIEW GUIDE

Do you believe that an understanding of bioscience helps you to carry out your clinical role?

State an example from your experience in which your knowledge of bioscience was needed.

How did you work out what to do for your patient?

Do you believe that the bioscience that you learnt as a student was adequate for your practice?

Have you yourself done anything to improve your bioscience understanding since you have been on placement?

APPENDIX 4

CRITICAL INCIDENT FRAMEWORK

- Think of an incident involving yourself and a patient that you considered to be very memorable. The incident may be something that made you feel happy, sad, frustrated, angry, frightened, satisfied.
- Describe your incident.
- Which part of your incident involved an understanding of bioscience.
- How did you make the connection what you experienced and bioscience

APPENDIX 5

Critical incidents related by the students as part of the data collection

Type Of Emotion	Incident	Awareness of Bioscience involvement	Connection of theory to practice
1. Sad Frightened Frustrated	cardiac arrest in a new patient	cardiac massage intravenous adrenaline administration .	Participation in external cardiac massage. Giving oxygen.
2. Satisfied	assisiting in carrying out a lumbar puncture on a patient	Extraction of fluid from the spinal puncture	Discussing what was happening with trained personnel.
3.Frightened	Tracheostomy toilet For a patient	Brain tumour with raised inter cranial pressure affecting the vital function of breathing.	Trained staff discussion.
4. Sad Angry Frightened	Results confirming the presence of multiple sclerosis In a young woman	Effects of multiple sclerosis on the body systems-paralysis.	Trained staff discussion.
5. Happy	Surgery resulting in resection and anastomosis instead of a colostomy. for a young man	Teaching the principles of colostomy care.	Consideration of altered body image in discussion with the patient.
6. Frustrated	Failing to communicate with a tracheostomy patient	Tracheostomy tube interferes with larynxgeal function	Trained staff discussion.
7. Sad	Witnessing a mylogram in a patient with spinal nerve compression.	Experience of pain in the foot and leg in when lying in certain positions.	Clinical practice
8. Sad	Witnessing a mylogram and CT scan in a new. patient	Seeing the spinal cord on X ray as in real life.	Clinical practice
9. Frustrated	Epileptic fit in a 23 yr old woman	Epilepsy affects brain Blocks communication with patient	Clinical practice/discussion

Type Of Emotion.	Critical incident	Awareness of bioscience involvement	Connection of theory to practice.
10. Happy	Acute respiratory embarassment because of a chest infection in an elderly patient.	Increased respiratory rate caused by a lack of oxygen	Trained staff explanation.
11. Satisfied	Aspiration of barium during x ray	seeing the patient's oesophagus swallowing.	Clinical experience
12. Frustrated	Language barrier in patients who usually speak good english	Effect of a mild cerebral vascular accident.	Clinical experience
13. Frightened	Grand mal-fit in a known epileptic. patient	Neurological inhibitors	Reading after the incident
14. Sad	Haemorrhage from a wound in a patient with liver disease.	Signs of shock with falling blood pressure, increasing Pulse and falling central venous pressure. Failure to form a clot at the bleeding site.	Trained staff explanation
15. Sad	Breast cancer with nausea vomiting and diarrhorea. in a middle aged woman	Malignant disorder Metastases.	Clinical experience
16. Frightened	Oesophageal haemorrhage in a male ex smoker patient	Central venous pressure drop. Unconciousness.	Trained staff explanation.
17. Angry Frightened Frustrated	Liver transplant rejection. in a young man	Body system failure. Confusional state due encephalopathy.	Trained staff explanation.
18. Frightened	Cardiac arrest. in a new admission	Cardio pulmonary resuscitation. Intravenous fluid replacement.	Practising rebreathing technique. Chest compression.

Type of Emotion	Incident	Awareness of Bioscience involvement	Connection of theory to practice
19. Angry Frustrated	Open abdominal wound. In a surgical patient	Stages of wound healing .	Practising wound dressing techniques
20. Angry Frightened	Chest pain for an A/E man	Carrying out electro-cardiograph. Observing patient colour.	From books/reading Clinical practice.
21. Angry Frightened	Hyper-pyrexia hypoxia Confusional state. in a child	Appearance of shock Cerebral malfunction	From books/readings.

APPENDIX 6

COMMON THEMES IDENTIFIED WITHIN THE C.I. DATA

Theme	Number of students		%
1. Clinical practice	6/21	=	28
2. Explanation by professional staff	8/21	=	38
3. Books/self reading	3/21	=	14
4. Practice skills	4/21	=	19
5. Emotions	21/21	=	100

APPENDIX 7

LEARNING STYLE QUESTIONNAIRE

Dear Student

This questionnaire is to help you discover how you best learn the subject of bioscience so that you may be able to understand the problems you identify in your patients because of a disorder to their physical state. The questionnaire will take about 20 minutes to complete and has no right or wrong answers. Think about the subject of bioscience and answer the questions by (√) if you agree and a (x) if you disagree next to the number of the question. Please be as truthful as possible about yourself and how you learn. You do not have to put your name or student number or any form of identification on the questionnaire. Your answers are to be completely anonymous.

1. I have strong beliefs about what is right and wrong, good and bad.
2. I often act without considering the possible consequences.
3. I tend to solve problems using a step by step approach.
4. I believe that formal procedures and policies restrict people.
5. I have a reputation for saying what I think, simply and directly.
6. I often find that actions based on feelings are as sound as those based on careful thought and analysis.
7. I like the sort of work where I have time for through preparation and implementation.
8. I regularly question people about their basic assumptions.
9. What matters most is whether something works in practice.
10. I actively seek out new experiences.

11. When I hear about a new idea or approach I immediately start working out how to apply it in practice.
12. I am keen on self discipline such as watching my diet, taking regular exercise, sticking to a fixed routine.
13. I take pride in doing a through job.
14. I get on best with logical, analytical people and loess well with spontaneous irrational people.
15. I take care over the interpretation of data available to me and avoid jumping to conclusions.
16. I like to reach a decision carefully after weighting up many alternatives.
17. I am attracted more to the novel, unusual ideas rather than practical ones.
18. I don't like disorganised things and prefer to fit things into a coherent plan.
19. I accept and stick to laid down procedures and policies as long as I regard them as an efficient way of getting the job done.
20. I like to relate my actions to a general principle.
21. In discussions I like to get straight to the point.
22. I tend to have distant, rather formal relationships with people at work.
23. I thrive on the challenge of tackling something new and different.
24. I enjoy fun-loving spontaneous people.
25. I pay meticulous attention to detail before coming to a conclusion.

26. I find it difficult to produce ideas on impulse.
27. I believe in coming to the point immediately.
28. I am careful not to jump to conclusions too quickly.
29. I prefer to have as many sources of information as possible-the more data to think over the better.
30. Flippant people who don't take things seriously usually irritate me.
31. I listen to other people's points of view before putting forward my own.
32. I tend to be open about how I am feeling.
33. In discussions I enjoy watching the manoeuvrings of the other participants.
34. I prefer to respond to events on a spontaneous, flexible basis rather than plan things out in advance.
35. I tend to be attracted to techniques such as network analysis, flow charts, branching programmes, contingency planning, etc
36. It worries me if I have to rush out a piece of work to meet a tight deadline.
37. I tend to judge people's ideas on their practical merits.
38. Quiet, thoughtful people tend to make me feel uneasy.
39. I often get irritated by people who want to rush things.
40. It is more important to enjoy the present moment than to think about the past or the future.
41. I think that decisions based on a through analysis of all the information are sounder than those based on intuition.

42. I tend to be a perfectionist.

43. In discussions I usually produce lots of spontaneous ideas.

44. More often than not rules are there to be broken.

45. I prefer to stand back from a situation and consider all the perspectives.

46. In meeting I put forward practical, realistic ideas.

47. I often see weaknesses and inconsistencies in other people's arguments.

48. On balance I talk more than I listen.

49. I think written reports should be short and to the point.

50. I believe that rational, logical thinking should win the day.

51. I tend to discuss specific things with people rather than engaging in social discussion.

52. I can often see better more practical ways of getting things done.

53. In discussions I get impatient with irrelevancies and digressions.

54. I like people to approach things realistically rather than theoretically.

55. If (I have to write a report I tend to produce lots of drafts before settling on the final version.

56. I am keen to try things out to see if they work in practice.

57. I am keen to reach answers via a logical approach.

58. I enjoy being the one that talks a lot.

59. In discussions I often find that I am the realist, keeping people to the point and avoiding wild speculations.

60. I like to ponder many alternatives before making up my mind.

61. In discussions with people I often find I am the most dispassionate and objective.

62. In discussions I'm more likely to adopt a 'low profile' than to take the lead and do most of the talking.

63. I like to able to relate current actions to a longer term bigger picture.

64. When things go wrong I am happy to shrug it off and put it down to experience.

65. I tend to reject wild spontaneous ideas as being impractical.

66. It's best to think carefully before taking action.

67. On balance I do the listening rather than the talking.

68. I tend to be tough on people who find it difficult to adopt a logical approach.

69. Most times I think the end justifies the means.

70. I don't mid hurting people's feelings so long as the job gets done.

71. I find the formality of having specific objectives and plans stifling.

72. I am usually one of those people who puts life into the party.

73. I do whatever is expedient to get the job done.

74. I quickly get bored with methodical, detailed work.

75. I am keen on exploring the basic assumptions, principles and theories underpinning things and events.

76. I'm always interested to find out what people think.

77. I like meetings to be run on methodical lines, sticking to laid down agenda, etc.

78. I steer clear of subjective or ambiguous topics.

79. I enjoy the drama and excitement of a crisis situation.

80. People often see me as insensitive to their feelings.

Thank you for your assistance.

Adapted from the Honey and Mumford Learning Style Questionnaire (1986)